Pit and Quarry

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Pit and Quarry

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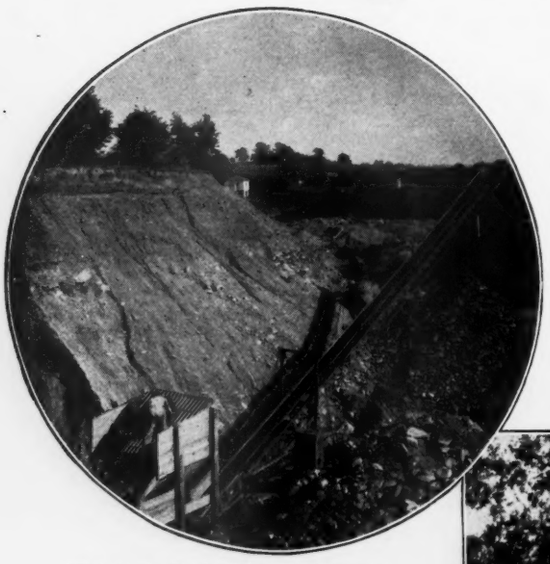
Stretching Out to Meet Changing Pit Conditions



This is the Barber-Greene Conveyor that grew up

WHEN the Barber-Greene Portable Conveyor was first installed at the washing plant of Homer J. Holl, N. Canton, Ohio, it easily handled the daily capacity. But pit conditions changed and a longer conveyor was needed. So the Barber-Greene was stretched out by the addition of extra sections—until it became a full fledged permanent conveyor.

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The owner of this South American plant believes in saving money. Three Barber-Greenes—a Permanent Conveyor, an "N" Conveyor, and a Bucket Loader are cutting costs for him.

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STANDARDIZED PORTABLE AND PERMANENT BELT CONVEYORS
SNOW LOADERS CAR UNLOADERS COAL LOADERS

Pit and Quarry

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HOW DO YOU SELECT YOUR FOREMEN?

THE true executive is the one who can get others to do his work for him and do it properly. Without the ability to unfailingly exercise good judgment in the selection of men, no one can attain the fullest measure of commercial success. Great industrialists and leaders of all time owe much of their position and prominence to the high value of their subordinates. In every case the ability to recognize, obtain and retain exceptional personal service was one of the underlying principles of success.

More particularly is this true with the "higher-ups"—the officials, department heads and superintendents. Depending upon the nature of the organization it is more or less true with foremen, for it is these that constitute the "key men" of industry—the direct connecting link between management and production. A good superintendent or a good foreman may be incapable of extracting loyalty and efficiency from a gang of loafers, but a bad foreman—one who may be cowardly, loud mouthed, self righteous, smug, insulting, "good fellow," or who is merely lacking in the qualities of leadership—can ruin the best bunch of men that ever worked.

Foremen selection would be a simpler matter and many industrial problems would be automatically eliminated, if the vagaries of human kind could be worked out on a scientific or mathematical basis. Fortunately, human nature is not so constituted, for which reason there is always present the element of chance in the selection of foremen. Personal judgment must assume the entire responsibility. It is an exceedingly difficult thing to properly estimate a man's ability or leadership qualities. It is all the more difficult when that man has been in the employ of the firm for a number of years and is just now meriting promotion. Larger pay and responsibilities have as often broken as made men. For anyone to have worked for a long period under the guidance of another, the graceful and unabused assumption of authority is a trying, and too often impossible, task.

Employee good will is among the major assets of any concern. It is to be cherished by all men in executive or supervisory positions. Such good will cannot be had if the foreman is arrogant or spineless, a "hale fellow well met" or a snobbish clam. Good will among employees will be lacking if the foreman fails to merit both the affection and respect of the men. It is nearly always good policy to have two or three men in line for every foreman's place. How such men act as "straw bosses" when temporarily put in charge constitutes a splendid test of ability and will very often identify a man as being a capable foreman. Examples of mistaken judgment are often eliminated thereby. This is perhaps the easiest and least risky way of getting an accurate check on the younger men of the organization.

WHEN SHOULD STANDARDIZATION BE INFLEXIBLE?

DURING 1896, railroad men in the United States were using 36 different types of axles and 58 different kinds of journal boxes. Today they are using but 6 different types of each. The 28 different couplers, the 20 different brake shoes and the 27 brake heads employed 30 years ago have been so standardized that only one kind of each of these items is now employed. These are but a few of the ways in which railway executives have standardized equipment, reduced expenses, and benefited the traveling and shipping public. They are but five examples of the countless thousands of individual economies that have been effected by American industry during the past 30 years—all to the benefit of the American people. There is strong movement to apply standardization in the Pit and Quarry industries and its progress is being watched.

There is one bitter, albeit unconscious, enemy to standardization, however, that needs to learn a great lesson. That enemy is the man who uses an accepted standard in any business as an alibi for the refusal to investigate the possible further economy or desirability of some new method or equipment. Without question, the tendency to stick to standards, once they have been adopted, is logical and advantageous. General abandonment of that tendency would largely nullify the value of all standardization. However, established codes or standards should never be considered the last word or held rigidly inflexible. Standardization should never be employed as a screen to the adoption of

more efficient or economical means. Any amendment to a recognized or accepted standard should have careful consideration and be weighed in the balance of good judgment. It goes without saying, however, that we are in business for the money to be made, and if more money can permanently come through a change from some standardized practice, then standardization should not be allowed to form an obstacle to possible economy or greater profits. That is not the spirit of standardization.

LOREE'S POLICY FOR EMPLOYEE RELATIONS

RECENTLY L. F. Loree, President of the Delaware & Hudson Railway, outlined in the Metropolitan Life Executive Service Bulletin, his conception of just what should be the minimum elements of "a decent, practical and efficient policy of industrial relations, including the underlying physical facilities for a fairly successful, moderately sized industrial plant." These elements were:

1—A man, at the time of employment, should—
- Be examined as to his fitness for the work he is to do.
- Be informed exactly as to what kind of work will be required of him.
- Be informed of the chances for instruction and promotion, and
- Be informed as to the wages to be earned.

2—An employee should be paid wages sufficient to—
- Enable him to live in comfort and conformity with others in similar work in his community.
- Educate his family.
- Provide, through thrift, for old age or disability, and
- Provide for increased earning through initiative, skill and application.

3—There should be a method by which an employee may protect himself against the majority of hazards of life, to wit: death, injury, old age, illness, loss of work, disability, or total incapacity.

4—There should be management which will assure—
- Continuity of employment.
- Prompt hearing of complaints.
- Unbiased decisions.
- Explanation of action or decision in cases of discipline.
- Opportunities for training and promotion, and
- Exclusion of favoritism.

5—Provision should be made for education and recreational occupation during free time.

6—There should be proper quarters and furnishings for—
- Work—meals—and recreation, as well as bathing or changing clothes.

This outline of employee relations policy is recommended to all those in search of better industrial relations, decreased labor turnover, or increased production.

HOW EFFICIENCY PERCENTAGES FLUCTUATE

BROADLY speaking there are only two ways in which operating and production costs can be reduced—by improvement of physical equipment, and by development of better methods of operation. The proper determination of the amount of money or effort expended in each of these two ways is the duty of every industrial executive.

This principle is well proved by a study of efficiency percentages. For instance, we may consider a plant that is equipped with machinery which, when perfectly operated, is capable of 85 per cent efficiency as compared with the best on the market. If the men operating this machinery are only 65 per cent efficient, the production result will be 65 per cent of 85 per cent, or about 55 per cent. Then, without change in the physical equipment of the plant, if the human element could be lifted to give, let us say 100 per cent efficiency, the production result would jump from 55 per cent to 85 per cent, an increase of 30 per cent.

On the other hand, if only the machinery efficiency is changed to 100 per cent, leaving the human factor unchanged, we get an increase in production of only 10 per cent. This increase has to be paid for by new expenditures and investments, whereas the improvement in the human factor can be effected by a comparatively small increase in outlay, since the wages are about the same on either scale of efficiency.

Not only does the above prove the value of lifting, wherever possible, the efficiency of the human factor, but it serves to indicate why one plant, with poorer equipment and facilities than its neighbor, can still sometimes show lower production costs.

4. OLD MAN EXPERIENCE SAYS

Man is like a tack—useful if he has a good head, or is pointed in the right direction. But even though he is driven, he can only go as far as his head will let him.

MANY SCIENTISTS AND ENGINEERS DISCUSS IMPORTANT INDUSTRIAL USES FOR LIME

By H. W. Munday

ABOUT one thousand representatives from chemical process industries assembled at Richmond, Virginia, for the spring meeting of the American Chemical Society from April eleventh to the sixteenth. Three hundred papers were presented among fifteen divisions. Two of these divisions were of particular interest to the pit and quarry industries; namely, the Division of Industrial and Engineering Chemistry, and the Division of Water, Sewage and Sanitation Chemistry, the first of these because of the Symposium on Lime consisting of twenty-two papers; the second, because of six of the papers. A general resume of those papers of interest to the pit and quarry field will be presented here, and many of them will be presented in full in early issues of Pit and Quarry.

The keynote of the entire conference was expressed in the theme that success in the operation of a chemical process is directly proportional to the understanding of the nature of materials going into the process, the nature of the reactions involved and the uses to which the product of the process will be applied. The Symposium on Lime developed this theme in a most complete manner.

The Problem of the Lime Industry

Professor J. R. Withrow, Ohio State University, as chairman of the Symposium on Lime opened the meeting on Wednesday, April 13th, with his remarks on the problem of the lime industry. This problem is to make suitable lime at a profit. Most lime manufacturers ignore the chemical industry which is non-seasonal. They seem to devote their efforts to construction trades which are seasonal. They send the cream of their lime to the construction trade and whatever is left to the chemical trade. This produces unnecessary variation in product. It damages lime industry in the eyes of the chemical manufacturer. The lime manufacturer must study his consumers' problems to get the business which should go to the most fundamental and lowest cost alkali-lime and to get the price support which will insure the maintenance of essential standards of raw material effectiveness. The lime problem met an early fundamental solution in the work of Black in the eighteenth century when he discovered the chemical relationship between calcium carbonate and calcium oxide. The problem of any chemical industry is made up of a series of problems which can be organized into three or four main groups: (1) The problem of the market and of the economics; (2) The problem of the chemistry which can be utilized to meet both the market and the economic situation; (3) The engineering which is made necessary by the chemistry and the market and economic situation. The problems of the market and economics in the lime industry are tied up with the nature and location of limestone deposits, the transportational relations to markets and the relation to industry which are consuming the lime. The chemical and engineering problems center around the chemical engineering operation of calcination and those questions which are raised by the market demand.

The Consumer, Market, Lime Business and the Chemical Industry

Charles Warner, president of the Charles Warner Company and of the National Lime Association, discussed this subject at the Symposium on Lime, Wednesday, April 13th. Mr. Warner was particularly well fitted as he has been active in promoting the idea of cooperation within the lime industry for the purpose of solving technical problems in which individual companies are mutually concerned and in developing close association between the lime producer and consumer to the benefit of both.

Mr. Warner emphasized the great importance of modern plant control and laboratory supervision in the manufacture of lime in order to produce higher grade and more uniform lime products. He classed modern lime manufacture as a chemical enterprise. The physical characteristics best suited to each industrial process can be best determined by thorough cooperation between the technical men of a modern lime plant and the technical men of the industry to be served.

"This is an age," Mr. Warner said, "where the open door in nearly all cases is the real way to build up American industries, and I join with others who are convinced that our American industrial supremacy in many lines is due to the broad cooperation that has developed in so many places, so as to utilize the best thought, and all thoughts, in the development of every enterprise. Hence my appeal for frank and full cooperation to assist in improving the uses of lime in the many industries now consuming it in our industrial life.

"It is surprising how many manufacturers in all industries, including lime, still believe that they have some improvement or scheme in their processes that is better than their competitors, when nine times out of ten their competitors as a whole have many more successful ideas on the process than the secretive one.

"Even with the awakened interest and extensive research effect of the past few years bearing upon lime and its uses, I believe few realize that we are dealing with a situation involving thousands of possible combinations. Most of us realize that we are only beginning to learn some of the important and vital characteristics of lime which so considerably influence its satisfactory and economic use."

Present Progress and Future Tendencies in the Lime Industry

Oliver Bowles, superintendent of the Non-Metallic Minerals Experiment Station, U. S. Bureau of Mines, outlined the present progress and future tendencies in the lime industry on Wednesday, April 13th. Rapid progress has been made in lime technology. Mechanical equipment is more widely used in quarries. There is a growing tendency toward underground mining. Kiln efficiency has been greatly improved. A study has been made of the effect of steam on the calcination process. The uses of lime have greatly multiplied and the specifications are becoming more and more exacting. As a result much research has been directed toward the qualities and properties of lime, and to the effect on lime of temperature and time of burning. Some progress has been made in the development of equipment for burning spalls into lime, and thus conserving waste, an important problem in view of the tendencies in modern practice toward increasing percentages of fines.

Bridging the Gap Between Research and Profits

W. E. Carson, president of the Riverton Lime Company and a pioneer in the field of lime technology, enlivened the proceedings at the Symposium on Lime, Wednesday morning, with his remarks on bridging the gap between research and profits in the lime industry. The former lack of appreciation on the part of the lime industry of the possibilities for application of science was pointed out and the gradual awakening to the need for chemistry and engineering, brought about largely through the efforts of the National Lime Association, was traced over the past two decades. The necessity for the proper appreciation, on the part of both producer and consumer of lime, of the fact that lime is a chemical material was stressed and the advantages accruing to both through the practice of buying on specification were pointed out. It is only on this basis that the cost of research and chemical control in lime production can be justified. The romance in the development of the lime industry was traced to the chemist, and in Mr. Carson's opinion the chemist has had much to do with the awakening of the lime manufacturer.

Lime Used in Causticizing

A. W. Bull presented a paper, on which he and J. V. N. Dorr had collaborated, concerning limes used in causticizing and some variables affecting their behavior. J. V. N. Dorr is president and A. W. Bull is research chemist of the Dorr Company. The paper was based upon a study of conditions, particularly in pulp mills, which affect causticizing rates, settling rates of sludges and lime and soda efficiencies. The causticizing of soda ash with lime to produce caustic soda is of importance not alone in the production of caustic as such but also as an intermediate process in the paper, soap and other industries.

The lime functions as a causticizing agent in the production of caustic soda from soda ash by liberating the strong base, sodium hydroxide. The precipitation of the calcium carbonate as a mud removes suspended impurities from the sodium hydrate solution. Either quicklime or hydrated lime can be used. The quicklime is given preference. It must be low in magnesia, highly reactive chemically, quick settling, quick slaking and must have an available lime content of 85 per cent or more.

Experimental results were given to show that the method of causticizing is of great importance in determining the physical properties of the calcium carbonate produced, and it was pointed out that this in turn will control the size of chemical equipment needed for a causticizing plant with given capacity. The nature of the causticizing reaction was discussed, and it was shown that in reactions of this kind the size of particles in the final precipitate may be determined by the size of particles of the lime after slaking.

Composition of Commercial Limes

J. M. Porter of the Bureau of Standards presented a paper entitled "The Composition of Commercial Limes and Their Specification In the Chemical Industries" at the Symposium on Lime, Wednesday morning. Lime is used in 115 industries in many different processes. From 1922 to 1927 the consumption of lime in the United States has mounted from 3,639,617 short tons per year to 4,580,000 short tons per year. About forty per cent of the lime used finds its way into the chemical industries because it is a cheap alkali or neutralizer. It is produced by burning limestone, i. e., subjecting broken limestone to a temperature of between 1800 and 1900 degrees F.

In such chemical industries as glass manufacturing, leather tanneries and some other twenty-six chemical industries lime must be of high purity that the chemical products will be of the best grade. Again, in the manufacture of food products, pharmaceuticals, water purification, and creameries, lime must be free from poisonous materials, such as arsenic. The Bureau of Standards has completed

an analytical study of thirty-five samples of lime produced for use in the chemical industries. The samples came from widely scattered regions of the country and it is interesting to note that they were of high purity consistently and were free from toxic compounds.

Of thirty-six representative samples of commercial limes analyzed, the high-calcium quicklimes averaged approximately 95 per cent CaO and the high-calcium hydrates, approximately 73 per cent. Four samples showed a relatively high manganese content, yet the maximum was less than 0.2 per cent in Mn O. P_2O_5 was detectable in a few samples only, in the magnitude of 0.01 per cent. All of the samples were practically arsenic free. The R_2O_3 content was uniformly low. Solubility in 1:0 HCl, "available lime" and CO_2 were also determined. A table giving the results of the analyses with a discussion of the methods was presented and the adaptability of the limes for various chemical processes is included.

Lime Problems of Agriculture

J. A. Slipher, Ohio State University, discussed this subject before the Symposium on Lime, Wednesday morning. Lime is required in soils for the normal growth of crops and is used as a soil conditioner for three purposes mainly. First, it is a granulating agent affording permeability to roots, accessibility to water and freedom of air movement. Second, it is a chemical conditioner by neutralizing acids which exist in lime deficient soils. Third, it serves as a regulator of the essential biological processes. The nitric acid unites with it to form an assimilable plant food for crops. Other acids may be produced during decay, which, if not neutralized by the presence of a base may accumulate to the point of preventing further decomposition.

A proper supply of lime in the soil results in the better growth and quality of crops produced. With certain crops, a good supply of lime in the soil favors early maturity. Also, a good supply of lime is a protection against certain diseases. Mr. Slipher advocated fractional liming as a method of solving the mechanical handling problems of the farmer. A study of 17 liming experiments in U. S. brings out that fractional rates of liming are more efficient per unit of lime than are full applications. The experiments received were ones in which direct comparisons were possible and involved a wide range of soils. The superiority of light rates was found to hold true for rotations that included such crops as corn, wheat, oats, clovers, barley, timothy, and alfalfa. With all crops except one instance of alfalfa, the first increment of lime gave relatively more crop increase than did each additional increment. While the lime additions were arithmetic, the crop responses stood in geometric relation. Coincident with this relationship is a similar one with reference to change of soil reaction by lime. The first increment shifts the soil reaction (in terms of pH) more than does each increment supplied in multiple additions.

Softening and Purification of Water

C. P. Hoover, a recognized authority and consulting engineer on water purification, discussed this subject before the Symposium on Lime, Wednesday afternoon from the standpoint of the use of lime. In the process industries the quality of the water may be a determining factor in success or failure, and results of extensive tests in connection with many of the more important specific problems such as split treatment sterilization with lime, recarbonation, automatic chemical dosage through pH control, and the adaptation of mechanical equipment, will be presented and their relation to industrial and domestic problems discussed. Hard water is one of the most disagreeable and expensive of industrial and household commodities and its cost and inconvenience are just beginning to attract the consideration they deserve. The yearly losses caused by hard water in increased plumbing costs, heat inefficiency due to boiler scale, soap costs, deterioration of fabrics, inferiority of products and the loss of chemicals in the process industries are considered of real economic importance. A few facts only are needed to call attention to these needless wastes.

In the case of a typical city of intermediate size it is estimated that it would cost $150 a day to soften the water, whereas the saving in soap alone would amount to $500 a day to say nothing of the comfort and convenience from soft water. A recent report of a survey by railway water service engineers showed that the savings resulting from softening of the locomotive water supplies on a number of roads ranged from $1,500 to $8,000 for each locomotive a year. The savings in power plants and industrial plants are of the same order.

A more extensive use of lime in water softening has been held back because of the limited results that could be obtained in reduction of hardness and because the softened water was not stable. Hardness is now further reduced by resorting to: 1st. The hot process; 2nd. Excess lime treatment; 3rd. Split treatment; 4th. Excess lime followed by carbonation; 5th. The use of compounds of alumina; and 6th. Substitution of zoolite for soda ask to remove non-carbonate hardness.

Stabilization may now be accomplished by recarbonation. Lime softening is exceptionably well adapted to the treatment of a badly polluted hard water because coagulation is improved, organic matter, color, objectionable gases and aron are removed, bacteria are killed making it unnecessary to depend on chlorine if tastes and odors are feared, thereby making it sometimes possible to produce a satisfactory potable water from a badly poluted water high in organic matter, even though all other

processes fail. It is a real adjunct to water purification because it increases the efficiency of sedimentation and filtration processes.

Lime in Butter-Making

Professor O. R. Overman, University of Illinois, in speaking on this subject at the Symposium on Lime, Wednesday afternoon, pointed out that the dairy industry, because of lime, has been an important factor in relieving the slump in agriculture. New methods of handling and transporting cream, developed since the latter part of the nineteenth century, have led gradually to a change from the small creamery in the predominantly dairy sections of the country where the cream was hauled directly from the farm to the creamery by the farmer himself, to the centralized creamery, which depends not upon cream produced in the immediate locality, but upon cream shipped for many miles to the central point.

The history of the development of butter making as an art from the earliest times to the middle of the nineteenth century was first discussed. From this time on the development of the art as it gradually changed into an extensive industry based upon scientific and economic principles is carefully traced. One of the problems met with during this change was the handling of sour cream. This problem led to a study of the use of alkaline substances for the reduction of the acidity of the cream and the development of methods by which lime is satisfactorily used for this purpose. The advantages of neutralization of acidity and the effects on increased yields and superior keeping quality of the butter was outlined.

Lime for Bleaching and Sterilization

A. H. Hooker, Hooker Electrochemical Company, discussed the problems of bleach manufacture in a paper entitled "Importance of the Proper Lime in the Use of Liquid Chlorine for Bleaching and Sterilization" on Wednesday afternoon before the Symposium on Lime. The scouring and bleaching of textiles is one of the oldest technical uses of lime. Authentic records date back to 350 B. C. at which time Xenophon records the wrecking of a ship near Marseilles with a cargo of raw linen and the lime necessary for bleaching.

The use of lime is restricted largely to the vegetable fibres such as cotton, linen and jute. The treatment of wool with lime is even still in the experimental stage. The principal uses of lime in textile mills are in the processes of cleansing and dyeing the goods. Four separate operations are involved (1) boiling out (2) bleaching (3) kier liming and (4) dyeing. Textile mills also use lime for water softening for making mercerizing caustic and for recovering waste lyes.

High grade lime is satisfactory and any kind of high grade lime is suitable for kier liming. For the other uses, lime of special quality must be used. The lime should have a non-volatile base, an iron and alumina content of less than two per cent, a magnesium-oxide content of less than three per cent, a silica content of less than 2.5 per cent and a calcium oxide content of more than 94 per cent. The preferred lime is fine, free from lumps and very reactive chemically. For dyeing operations, the lime should be practically free of iron.

Lime in the Paper Industry

The use of lime in the paper industry was explained by P. A. Paulson of the Kimberly Clark Paper Company at the Symposium on Lime, Wednesday afternoon. Mr. Paulson is the inventor of the milk of lime system for the manufacture of bisulphite liquor which is used by the Kimberly Clark Paper Company.

Lime is an essential material in either the cooking medium or in the preparation of cooking liquors for pulp production by the sulphite, soda or sulphate processes as well as in the cooking of straw and rags. The history of early paper making was briefly outlined showing the advancement of that branch of the industry from the time paper was first made up to the present time and listing the various raw materials used for pulp making with a discussion of the function and use of each. A short sketch of a modern paper mill and the different processes in use for resolving raw materials into paper making fibres was given. The phase of each process in which lime is used was explained in detail.

Lime in the Beet Sugar Industry

Ralph Shafor, Great Western Sugar Company, presented a paper on this subject before the Symposium on Lime, Wednesday afternoon, which developed into a discussion of the fundamental factors entering into the rate of decomposition of limestone lumps in kilns of the shaft type with emphasis on the transfer of heat. Experiments indicate that rates are controlled primarily by rate of head conduction through CaO layer on face of decomposing lump. A discussion of and method for the evaluation of lime for use in the Steffen Reaction to produce $3CaO.C_{12}H_{22}O_{11}$ was given.

Role of Lime in Tanning

This subject was presented by George D. McLaughlin, University of Cincinnati, on Wednesday afternoon before the Symposium on Lime. Although the leather industry is one of the oldest, developments have come slowly. Recent years have seen a tremendous advance in scientific knowledge and control. In Mr. McLaughlin's paper the structure of animal skins was described and the procedure in the unhairing process outlined. The following reasons for the continued preference for lime for unhairing were given and discussed: Its mild action; the constant pH value (12.5) of the

solution; only slight digestion of collagenous materials; saponification of portion of fat with formation of a curdy soap with little water holding capacity; its effect on the molecular character of the skin proteins. This latter effect is quite involved and is still under investigation. Specifications for lime should include high CaO content, low iron and magnesium content and low settling rate of suspension.

The conversion of animal skins into leather is brought about by a series of complex chemical reactions. A general method of operation is followed but the varied structure and composition of skins, individually and collectively, makes certain variations in the details of the procedure. The production of leather involves the action of alkalies, enzymes and bacteria in removing certain proteins, and the interaction of the remainder with tanning materials, oils, soaps, emulsions, mordants, dyestuffs, gums, resins, and other complex substances.

The use of lime is practically all confined to the unhairing or depilation of the hides. In order to protect the skin after this process it must be soaked in lime water before dehairing. The lime is either used in single vats or a series of vats. The action of the lime is to swell up and soften the epidermal cells and dissolve the mucous layer, thereby loosing the hair so it may be removed mechanically. The epidermal cells, largely composed of keratin, a substance rich in sulphur, are more readily soluble in alkaline sulphide solutions and consequently the addition of such compounds hastens the reaction.

Disposal of Pea Cannery Wastes

L. F. Warrick presented a paper entitled "Lime Treatment in Disposal of Pea Cannery Wastes" before the Symposium on Lime, Wednesday afternoon. This paper gave details and results of an investigation conducted at Poynette, Wisconsin during the past canning season in the treatment of pea cannery wastes with lime and ferrous sulphate. It was demonstrated that the oxygen demand of such wastes can be reduced approximately 75 per cent by screening and tank treatment with the application of 7¼ pounds of lime and 3¼ pounds of ferrous sulphate per one thousand gallons. Sludge is readily removed and dried and has a fertilizer value estimated at $3.50 per ton. The estimated cost of waste treatment for a two line cannery was $13 to $15 per day of capacity operation.

An X-Ray Study of Limes

Marie Farnsworth of New York University presented one of the most interesting papers before the Symposium on Lime, Wednesday afternoon, concerning her x-ray studies of limes having different plasticities.

Marble and precipitated calcium carbonate were burned in air at 1800, 2000 and 2200 degrees F. and marble in a vacuum furnace at temperatures from 1200 to 2400 degrees F. in steps of 200 degrees. The plasticity of all these samples is measured and x-ray powder photographs of the oxides and hydrates taken. The samples burned in a vacuum were found to be more plastic than the samples burned in air. The CaO samples which give a plastic hydrate give a face-centered cubic pattern with unit edge 4.79 degrees; the plastic hydrates give a hexagonal pattern with an axial ratio 1.40. The patterns of the less plastic samples are complicated by additional lines corresponding, if CaO films, to strong lines of the $Ca(OH)_2$ and $CaCO_3$ films, and if $Ca(OH)_2$ films, to strong lines on the $CaCO_3$ film. In every case, the intensity of these extra lines can be taken as a direct measure of the plasticity of the sample; these lines are the same for samples burned at high and low temperatures, but for samples burned at the higher temperatures, the intensity is less. Experiments were not carried out with over-burned samples. It is interesting to speculate as to whether or not the $Ca(OH)_2$ and $CaCO_3$ are the cause of the decrease in plasticity of the lime or simply an accompanying phenomenon. It is hard to see why $Ca(OH)_2$ present in lime should decrease he plasticity when it is all converted into $Ca(OH)_2$ before the plasticity is tested. However, the $Ca(OH)_2$ already present might act as centers of crystallization and thus give rise to larger crystals which would be less plastic. Since only $Ca(OH)_2$ and not $CaCO_3$ is present in appreciable amount in the more plastic air-burned samples, it may be only the $CaCO_3$ present which causes a decrease in plasticity. It is easy to see how $CaCO_3$ present in fairly large amount would decrease the plasticity by decreasing the amount of oxide present. By this it is not meant that a simple admixture of $CaCO_3$ would materially decrease the plasticity but if the $CaCO_3$ coated some of the grains of oxide and slowed down the rate of hydration, the plasticity would be decreased. X-ray photographs of commercial samples show that $CaCO_3$ is always present in samples of low plasticity. The presence of $Ca(OH)_2$ and $CaCO_3$ offer no explanation of the low plasticity of over-burned lime but here the additional complication of sintering enters in.

Effect of Particle Size on Hydration of Lime

F. W. Adams, Massachusetts Institute of Technology, discussed the question of the effect of particle size on the hydration of lime before the Symposium on Lime, Thursday morning. The properties of hydrated lime and milk of lime are of extreme importance in the many industrial processes using these reagents and Mr. Adams has been engaged during the past two years on a systematic investigation of the requirements of the hydrate for certain uses and the conditions affecting its properties. The conditions studied include those

affecting particle size, settling rate, reactivity and plasticity.

Samples of an Eastern high calcium lump lime of average diameter of particles varying between 10.0 mm. and 0.1255 mm. were hydrated in an experimental apparatus to produce dry hydrates. After ripening the hydrates were tested for moisture content, rate of reaction with hydrochloric acid, rate of settling, plasticity and putty volume. It was shown that the size of hydrate particles decreases with the diameter of the quicklime particles from which produced; a more reactive hydrate with lower settling rate is obtained from a finely ground quicklime. In the range studied, for all sizes of quicklime particles of 5.0 mm. or below a satisfactory plasticity to classify the product as a finishing hydrate is attained; the values running between 265 and 386. A 10.0 mm. diameter particle yields an inferior hydrate of plasticity 147. Putty volumes vary between 137 and 180 cc. from 100 gms. of hydrate, following the variations in plasticity.

High Temperature Whitewash

C. P. Arthur discussed this subject before the Symposium on Lime Thursday morning and his paper was a collaboration of his work with W. B. Mitchener and J. R. Withrow. Whitewash which is a thin mixture of slaked lime and water has been used for centuries. Its uses have been increased as its properties became better known and scientific research is developing new formulas which will increase the use still further.

The most common use of whitewash is to improve the appearance of structures. This it does by its color and covering capacity. It also has a distinct sanitary value due to its lime content and the fact that white surfaces tend to promote general cleanliness. It also prevents deterioration and when the cost with other methods is compared it proves to be the most economical. E. P. Arthur discussed the use of high temperature whitewash. A lime whitewash for the brickwork of high temperature industrial furnaces can be prepared by adding small amounts of silicate of soda to a lime-water slurry. The paint can possibly be improved by addition of common salt and plaster of paris, also in relatively small amounts. The use of lime paint on the brickwork of furnaces not only improves appearances but also helps to reduce infiltration of cold air. If thoroughly mixed and applied in a thin coat to clean brickwork a silicate-lime whitewash will not crack, flake, or dust off under service conditions at temperatures as high as 350 degrees F. and slightly higher.

Lime in Open Health Practice

C. H. Hertz, Jr., of the Pittsburgh Station of the Bureau of Mines, presented a paper on the economies through the use of lime in open hearth practice before the Symposium on Lime Thursday morning. The results of the extensive investigations made by Mr. Hertz indicates that substantial benefits result in the utilization of quicklime in fluxing. A brief outline was given of the reasons for using lime in the basic open-hearth process, and the factors affecting the use of burnt lime were outlined. These factors are: The effect of burnt lime on the time necessary to make a heat of steel; the relative prices of scrap and pig iron; the relative costs of lime and limestone; and the quality of the lime, with particular regard to its sulphur, silica and carbon dioxide content.

Function of Steam in Lime Kilns

E. E. Berger, New Brunswick Station, Bureau of Mines, gave a brief analysis of the function of steam in the lime kiln before the Symposium on Lime, Thursday morning. The rate of calcination of limestone in equal currents of air, steam and helium was determined at increasing constant temperatures from 600 to 1000 degrees C. The calcination rate was slightly different in each gas but this variation was accounted for by the effect of the physical properties of each gas on the transfer of heat to the limestone and not to any chemical or catalytic effect which the gases might have on the limestone during the calcination process. It was shown that the difference in physical properties of the gas entering the lime kiln would not be changed sufficiently by the addition of a small quantity of steam to have any appreciable effect on the calcination process. A study was also made of the effect of steam and waste flue gas on the combustion of the fuel and an explanation was given for the action of these gases in preventing the clinkering of the ash and increasing the length of the flame.

Rotary Kilns vs. Shaft Kilns for Lime Burning

Richard K. Meade discussed this subject before the Symposium on Lime Thursday morning. The discussion was along the lines of the comparative (1) suitability of the kiln to the raw materials; (2) the quality of the product produced; (3) the economies of labor, fuel and repairs, and (4) the first cost of installation.

The conclusions to be drawn from Mr. Meade's remarks are that the rotary kiln is best suited to burning lime, (1) Where run-of-kiln lime will meet the requirements of the market, (2) Where quarry spalls, highly crystalline and very soft limestones, shells, marl, etc., are to be burned; (3) to large cutputs; (4) to continuous operation; (5) where labor is high; (6) where fuel is cheap, where oil is obtainable as a fuel, or where pulverized coal can be used; and (7) where waste heat boilers can be installed and the surplus power so obtained em-

ployed to advantage in other operations. The shaft kiln is suited, (1) where it is advisable to select the lime in order to secure a product which will meet the most desirable trade; (2) where the limestone is hard and compact; (3) to small operations; (4) where low first cost is desirable; (5) where the demand for lime is likely to be variable; (6) where labor is cheap and fuel high; (7) where power is not obtainable; and (8) where dust is likely to cause a nuisance.

The whole discussion can be summarized in fourteen points:

1. The rotary kiln is suitable for burning all classes of limestone including quarry spalls, limestone which decrepitates on heating, soft chalky limestone, coral-sands, shells, marl, and other forms of calcium carbonate which can not be burned in shaft kilns.

2. There is little choice in the quality of the run-of-kiln lime from shaft and rotary kilns, but the product from the former can be more easily hand picked, giving an opportunity to produce selected material of higher quality than the average.

3. With care lime can be burned in the rotary kiln which will meet the requirements of the building trade as well as chemical and metallurgical users.

4. It is possible to burn lime more thoroughly in a rotary kiln than in a shaft kiln.

5. The rotary kiln is better suited to the production of pebble lime and pulverized lime than is the shaft kiln.

6. The quarrying of stone for a rotary kiln can be more economically done than for a shaft kiln.

7. The crushing of stone for a rotary kiln can be done more cheaply than the sledging and hand sizing of the rock for a shaft kiln.

8. The labor required to operate a rotary kiln plant is much less than that required to operate shaft kilns. The larger the operation the more pronounced the difference.

9. The shaft kiln is more economical of fuel than the rotary kiln, particularly where producer gas is used to heat the latter.

10. Considerable of the heat lost in the flue gases of the rotary kiln can be recovered and converted into power by the use of waste heat boilers.

11. Repairs to the rotary kiln are less than those of a shaft kiln and the loss of time due to repairs is also much less.

12. The cost of a rotary kiln plant is about 25 to 30 per cent more than that of a shaft kiln plant of similar capacity.

13. The power required to operate a rotary kiln is about 5 to 8 kw.hr. per ton of lime produced. If the kiln is heated by pulverized fuel the power required is from 13 to 16 kw.hr. per ton of lime.

14. The dust losses from a rotary kiln lime plant amount to from 1 to 3 per cent of the stone burned.

Science and Engineering of Lime Burning

V. J. Azbe contributed one of the most interesting papers before the Symposium on Lime, Thursday morning, on this subject. Mr. Azbe pointed out that there are very good opportunities for improvement in burning lime but only a few manufacturers are making very serious efforts to manufacture a product having desirable characteristics. Many will never apply any science or engineering until forced to by competition.

The changes occurring in lime when it is burned, and the variation in its properties with conditions of burning, are due to the changes of structure occurring within it was pointed out. Its properties are more a matter of arrangement of unit cells than of their chemical composition. This arrangement is affected by both temperature and duration of burning. The conditions of burning ordinarily obtained are compared with those most to be desired. Among the methods suggested for obtaining better burning conditions and higher kiln efficiencies are the recirculation of kiln gases, arrangements for constant supply of producer gas, and improved methods of drawing.

Needs and Future of Lime in the Chemical Industry

J. R. Withrow concluded the Symposium on Lime Thursday morning with a summation of the needs and future of lime in the Chemical Industry and a splendid appeal for research in the production and uses of lime.

The chemical industry will never cease to need low priced alkaline materials. Chemical industry is so interwoven with our industrial development that its expansion is a matter of necessity and the lime industry must also expand if its managers do not neglect its opportunities and permit more expensive alkaline materials to do the work which lime should do. Lime is a great time saver in chemical plant operation provided the producer of lime does not supply a quick settling lime where a slow settling lime is needed to furnish proper proportions in a mixture at all times. Provided also he does not furnish a slow settling lime when a quick settling lime is required. In this latter case the extra time may cut into the plant capacity. Lime manufacturers must learn that the chemical industry requires the cream of the lime production and will repay for careful study of its needs.

Water Treatment to Prevent Corrosion

John R. Baylis discussed this subject before the Division of Water Sewage and Sanitation Chemistry on Wednesday, April 13th. No treatment of water will prevent corrosion of iron where a fresh metal is exposed. Water at the solubility equilibrium of calcium carbonate and containing over 25

ppm. of $CaCO_3$ will precipitate calcite where corrosion takes place and aid in forming an impervious protective coating. The most durable practical coating, with the possible exception of cement lining, does not last many years in corrosive water, but any coating that lasts till a protective film is built up from the constituents of the water will give good protection when the water is more alkaline than the saturation equilibrium of $CaCO_3$.

To waters with less than 25 ppm. of $CaCO_3$ lime should be added to produce the desired alkalinity. To others either lime or soda ash may be added. For corrosive water such as is found in New York, Atlanta, and many other cities it is believed that a fair estimate of the loss due to the corrosive property of the water is at least $1.50 per capita annually. All evidence indicates that iron pipe, whether galvanized, painted with coal-tar pitch, or cement lined, is durable only when the water is saturated with calcium carbonate or is more alkaline.

Cement Lined Water Mains

Harry Y. Carson discussed this subject before the Division of Water Sewage and Sanitation Chemistry on Wednesday, April 13th. Most municipal water supplies, low in alkalinity, are not only troublesome from the standpoint of producing tubercles, but are also corrosive to the calcium compounds in cement. When Portland cement is used as an inside coating for cast iron pipe, a fortunate chemical reaction takes place at the surface of the cement which slows up the action of the water both on the cement itself and on the iron. A precipitation of ferrous hydroxide takes place from the flowing water in the main and this hydroxide enters the outer pores or capillaries of the cement. The ferrous hydroxide seems to exchange places with a certain amount of calcium hydroxide; following this initial reaction the diffusion of calcium to the water is greatly slowed up, and, in fact, the general function of the cement lining on the inside of iron pipe seems to be one of greatly slowing up the ordinary mechanism of corrosion in a more positive manner than is done by other forms of commercial coatings.

From the data which has accumulated to date on the subject of commercially lining cast iron pipe with cement, it appears that this development has yielded an acceptable solution to an old water works problem, increasing the durability and service value of cast iron pipe and, above all, preventing loss of capacity due to tuberculation.

Recarbonation of Softened Water

Charles P. Hoover discussed this subject before the Division of Water Sewage and Sanitation Chemistry on Wednesday, April 13th. When water for a public supply is softened by lime, a certain amount of difficulty results from the deposition of calcium carbonate on the filter sand and in pipes. This difficulty is being prevented by adding carbon dioxide to the water before filtration. This process is being used at Defiance, Delaware, and Newark, Ohio, at Miami, Florida, and at several other cities. At Columbus, Ohio, a plant is now under construction to provide gas for recarbonation by making producer gas from coke and then burning it to complete combustion.

Deposit in Water Pipes

Edward Bartow and C. R. Henderson discussed this subject before the Division of Water Sewage and Sanitation Chemistry on Wednesday, April 13th. A sediment in the water mains at Davenport, Iowa, made it necessary to flush hydrants at frequent intervals, especially at dead ends. The trouble was lessened by eliminating dead ends and obtaining a circulation of water. The deposit may have come (1) from a slight amount of suspended matter remaining in the water after filtration or (2) from corrosion of the mains. The latter explanation seems most probable because deposits of hydrated oxide of iron were actually obtained from the inside of pipes. An attempt was made to decrease the amount of sediment by adding sufficient lime to reduce the free carbon dioxide to approximately 3 parts per million. During eight months, 62 tons of lime were used at a cost of $824. The improvement seemed to be too little to continue the addition of this quantity of lime. Pieces of cast iron from the main were suspended in water containing (1) sulfate of aluminum, (2) bleaching powder, (3) carbondioxide, and (4) lime. The decrease in corrosion when lime was added was not sufficient to warrant its continuance in the plant. The treatment of the water to the point of coating the pipes with a thin film of calcium carbonate as recommended by Bayliss may be worth consideration.

Electro-Osmosis Water Purification

A. S. Behrman discussed this subject before the Division of Water Sewage and Sanitation Chemistry on Thursday, April 14th. It has hitherto been possible only by distillation to remove sodium salts and similar soluble compounds from water. By the electro-osmotic process, however, it is now possible to accomplish this purification electrochemically. The process consists essentially in electrolyzing the water in a series of three chambered cells, the central chamber of each cell being separated by a suitable diaphragm from an electrode chamber on each side. The ions and colloids in the water are drawn through the diaphragms into the electrode chambers, which are rinsed continuously.

Except with waters of extremely high soluble salt content, it is possible by the electro-osmotic method to prepare water of a purity equal to that

(Continued on Page 88)

HOW WISCONSIN SAND AND GRAVEL COMPANY PRODUCES LARGE TONNAGE WITH ECONOMY

By E. D. Roberts

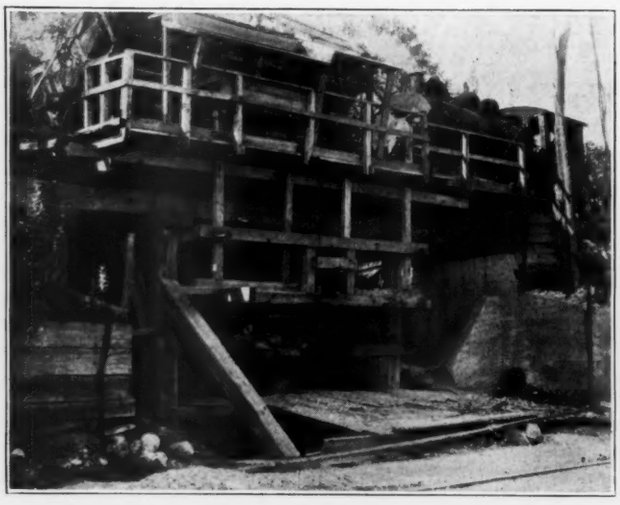
THE Wisconsin Sand and Gravel Company's plant and pit are located a short distance east of North Lake alongside of the Chicago and Northwestern Railroad Company's main double track line over which most of the production is shipped to the main market—Milwaukee, 28 miles southeast of the pit. Most of the product sent to Milwaukee is retailed through dealers but some is sold to contractors who handle their own concrete aggregates from the car. The concrete paved roads, which radiate out of North Lake, also provide an outlet for truck shipments to the nearby territory.

Shovel Loading Into Car

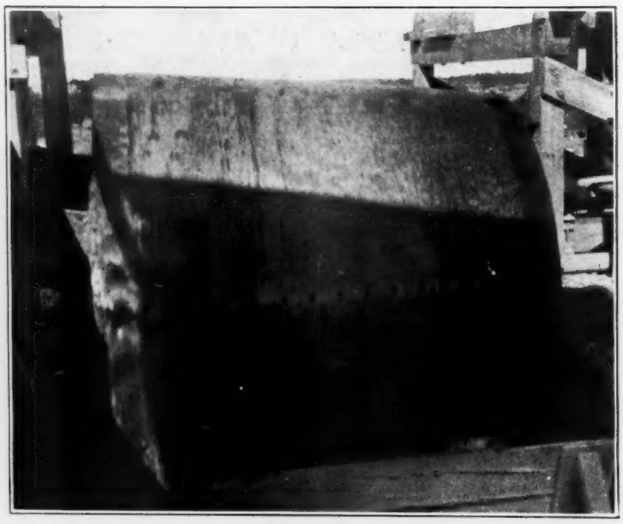
As is well known to those who are familiar with the geological formation of Wisconsin, most of the material which overlies the bed rock was deposited by the melting of the great glacier which at one time came down from the north carrying with it large quantities of sand and gravel which the glacier had scoured and ground from the rocky areas farther to the north. As the ice, which formed the glacier, melted, the sand and gravel carried therein was deposited in various formations depending upon the topographical conditions existing at the toe of the glacier. When the water had a chance to run away, as soon as the ice melted, the finer particles of material were carried off by the water, leaving the coarser material behind. Some of the resulting hillocks, called moraines, are very large and extend across the country for a considerable distance, but rarely so in Wisconsin. Most of the Wisconsin deposits of glacial materials run more than half and, in some instances as high as 80 per cent sand, resulting in low prices for sand, so that it is rare that we find a large deposit of coarse material in this state suitable for use as concrete aggregates.

However, the deposit from which the Wisconsin Sand and Gravel Company is producing its washed sand and gravel for concrete work is an ex-

Shovel Working on Face of Pit



Primary Crusher with Car being discharged into Hopper



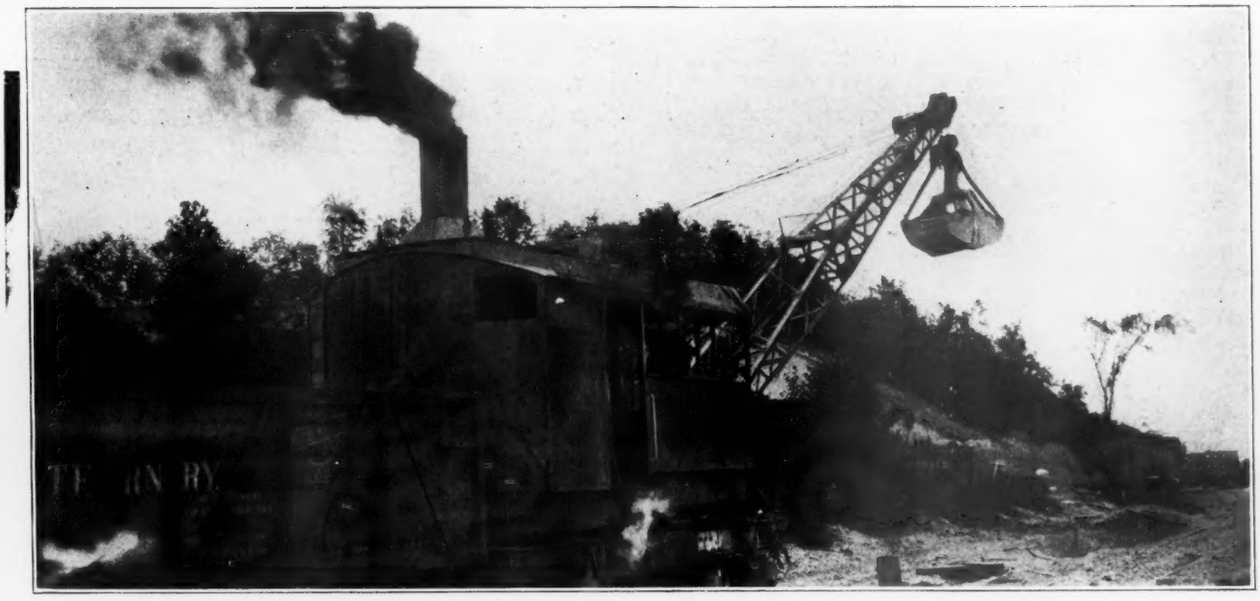
Close up of the Conical Screen

ceptional deposit of this latter type. Rising about 75 feet above the plain with less than a foot of soil covering, the deposit presents an ideal face for excavation by steam shovel. A sieve analysis of the material shows about 20 per cent sand and the balance gravel, part of which has to be crushed to make it marketable. When it is known that most producers in Wisconsin have an excess of sand to market, the value of this deposit can be easily recognized. Borings show that the same deposit extends downward for 60 feet, where water is encountered. Material for many years of production is available above the present pit floor level after which the Company will mine the remainder.

With their new Model 50B Bucyrus shovel, electrically operated, only two men are required in the pit, one man on the slope to bar down the gravel and the other man operating the machine. This shovel also shifts the pit tracks and does other work that could not be accomplished with a machine that was less adaptable. The shovel has two main motors, 100 horse power for the digging movement and a 40 horse power for the swinging gears, both operating at 440 volts alternating current. An electric tripping device on the dipper adds to the efficiency of the machine.

The shovel excavates the gravel and sand from the bank and dumps into 16 yard Western dump cars which are moved to the primary crusher by a 30 ton Davenport, standard gauge locomotive. The receiving crusher has been placed at the end of the pit so that only a very short haul is required. Arriving at the crusher, the cars are side dumped into a large hopper from which the flow of material to the number 12 Allis-Chalmers gyratory crusher is controlled by a sliding gate. Steel bars placed over

View of Pit Face from Top of Bunkers



Locomotive Crane Switching Cars

the top of the hopper keep any large rock from entering the crusher. As it is very seldom that large stone are encountered, there has been no trouble due to an accumulation of boulders.

A 36 inch inclined belt conveyor receives the discharge from the primary crusher and carries the material to a grizzly, located in the top of the secondary crushing building. As the mixed material falls on to the inclined grizzly, pieces over two inches in size slide into a chute leading to two of the secondary crushers located on the ground level. Material that will pass through the grizzly bars falls on to another 36 inches inclined belt leading to the washing and sizing screens.

This plant has four secondary gyratory crushers, two number 5's and two number 3's. The number 5's take the oversize from the grizzly, while the number 3's crush the oversize which comes from the sizing screens. The 24 inch conveyor carrying this oversize is so placed that gravel can be drawn from the bins and further reduced by the number 3 crushers. All four crushers are arranged to discharge directly on to the same 36-inch inclined belt that takes the fine material from the scalping grizzly.

Four short revolving conical screens are provided for sizing the material. These screens, manufactured under the Beezon Patents, are especially adaptable for use where a number of grades are required with but limited available space. The gravel is fed into the center of the screen which passes the material back and forth, producing and discharging a sized material for each travel. Water is sprayed into the screen to thoroughly wash the material and aid in the segregation of sand and fines from the gravel. Each grade falls into a chute leading to the proper bin below while the sand, water and silt is caught in a flume leading to a sand classifier.

View of Plant from Opposite Primary Crusher

The Sand Classifier

This classifier consists of a sloping box in which a series of paddles travel on the bottom and up the slope carrying the coarser particles and discharging them over the end of the box into a large tank. An overflow, placed at the lower end of the inclined box, allows the water and silt, carried in suspension due to the continuous stirring, to flow away to a settling basin.

The various grades of gravel and the sand are drawn off into railroad cars or trucks through spouts placed in the side of the bins. These bins have a capacity of 13 cars of gravel and 2 cars of sand. Forty cars can be spotted on the track for loading before the return of the Railroad Company's engine. Due to the need for continuous production during the warmer half of the year and the varying demand for the products, considerable material is temporarily placed in outside piles awaiting shipment. A 20 ton American Hoist & Derrick Company locomotive crane is used to form these storage piles. The locomotive crane switches the cars from the bins to the storage area, unloads and later reloads the sand or gravel for shipment.

Water for washing the sand and gravel is furnished through a 6 inch line by a Fairbanks-Morse centrifugal pump coupled to a 50 horse power motor. Plant water is furnished by a two inch centrifugal pump of the same make. Several types of motors are in use in this plant. A 150 horse power General Electric motor operates the primary crusher; two 50 horse power motors of the same make furnish individual drives for the two number 5 gyratory crushers, while one of the number 3's is operated by a 25 G. E. motor and the other by a 30 horse power Westinghouse motor. All other machinery of the plant is equipped with individual electric drives.

The plant produces 1000 cars of washed and graded material each month and with Milwaukee and vicinity for its market, production is maintained at a steady pace throughout the warmer months of the year. The Company depends on the outside storage to take care of peak demands and winter shipments.

Mr. I. M. Clickquennoi is the president of the Wisconsin Sand and Gravel Company and maintains his office at 204 Wisconsin Avenue, Milwaukee, Wisconsin. Mr. M. Flemming is plant superintendent assisted by Mr. C. E. Tuftee, who runs the plant office at North Lake.

Engineer Says We Are Losing Fight Against Losses by Fire

Major H. W. Lockett, research engineer in the New York office of Fred S. James and Company, calls special attention to the fact that earnest research into the progress of the nation since the beginning of the World War shows convincing proof that we are actually losing out in our warfare against fire waste. All statistics point to an increase of not more than 90 per cent for the past twelve years in the value of burnable property, compared with 10 per cent increase in the fire losses in the same period, he says.

Nor can any satisfaction be derived from resolving our fire losses, measured by the dollar, to a quantitative basis or by comparing it without increase in population, Major Lockett holds. This for the reason that Professor Irving Fisher estimates that the dollar, for the past two or three years, has averaged about 68 per cent of the dollar of 1912 in its purchasing power. On this basis, measured by the 1912 dollar, our fire losses are averaging over $350,000,000 per annum, so that from a quantitative standpoint they exceed those of 1912 by approximately 35 per cent.

Population of the United States during the period in question has increased only about 15 per cent. This would indicate that our per capita loss, from a quantitative standpoint, has increased 128 per cent. In other words, we are burning up two and a quarter more units of property per capita today than were destroyed by fire in 1912.

Rock-Dusting in Coal Mines

Recommendations of the American Engineering Standards Committee for standard practice in rock-dusting coal mines have recently been published by the United States Bureau of Mines, Department of Commerce, as Information Circular 6030. Several members of the Bureau of Mines staff served on this committee, whose recommendations are essentially in harmony with those of tentative specifications previously published by the Bureau in Serial 2606. As certain supplementary details contained in Serial 2606 are not included in the recommendations formulated by the American Engineering Standards Committee, that serial should be considered by coal-mine managements in conjunction with the committee's report now published as Information Circular 6030.

LUBRICATION IN THE PIT AND QUARRY INDUSTRY

By R. N. Van Winkle

IN a recent article the writer made mention that an executive should not be a figurehead but should have a fair knowledge of his industry as a whole and as intimate a knowledge as possible of every detail. With this in mind the writer is attempting, in so far as he is qualified, to give articles on details of the quarry and open pit mining industry, which details are quite often overlooked due to the importance and rush of daily operating and routine matters. The subject for this article is "Lubrication as Applying to the Quarry and Open Pit Mining Industry."

Lubrication is one of the many details with which the operator is confronted and one which cannot occupy too much attention, but which is more than incidental in quarrying operation. Lubrication quite often receives little or no attention aside from applying oil or grease regularly until a bearing fails, runs hot or burns out and then a change in lubricant is made based more on the assumption that a change will be beneficial or at least can give no worse results, than upon the relative merits of the new or older lubricant. It is not the intention to be technical in this article but to give a few fundamentals of lubrication and then to give tables or data based on experience and advice from reliable oil companies of the kind of lubricant that should be used for different places under ordinary circumstances in the quarrying and open pit mining industry.

In the operation of all machinery two kinds of friction, the thing lubricants are primarily used for, are encountered;—solid friction and liquid friction, both of which require power or the expenditure of power to overcome, and it is with this expenditure of power, delays, failures and maintenance cost that we are interested, as they all mean dollars and cents to us as operators. Keep in mind that friction means losses in three ways: the loss of power; the loss of the parts worn out, and the loss of labor involved in replacing.

While the writer knows of no way to intelligently measure the amounts in loss of parts worn out and loss of labor involved in replacing worn out parts due to friction, Mr. A. W. Friend, a lubricating engineer of The Standard Oil Company, in an article on plant lubrication published in this magazine recently said that a survey made some years ago by Professor Benjamin of the Case School of Applied Science, Cleveland, Ohio, based on various industrial plants in Ohio, showed that losses due to friction averaged 44.8 per cent of the total horsepower developed. Almost 50 per cent—just think of it.

Solid friction is the result from actual contact of moving surfaces, such as bearings or journals, as metals often tend to weld or roughen under pressure and wear causing resistance and therefore heat, which means excessive and continuous waste of power. Liquid friction is described as the friction caused by the lubricant itself and is the friction or resistance that the lubricant offers to motion. Light oil is used in automobile engines in winter and heavy oil in summer; summer, black oil (heavy) in quarries in summer and winter, black oil (light) in winter, due to liquid friction. In other words we use the oil that offers least resistance to motion or flow, which is known as Viscosity. Viscosity of oil is the same as the body fluidity or cohesion of oil, terms with which we are perhaps more familiar.

The lighter the body of the oil, the more rapidly it will flow and the lower the viscosity and vice versa. Viscosity is the most important physical characteristic of a lubricating oil, and is the point most used by the expert in considering the application of oil to the machine. There are, of course, many other things besides viscosity to be considered when selecting oils, such as gravity, flash and fire test, pour test, carbon content, etc., but these are questions best left to the expert or specialist.

Perfect lubrication, provided there is such a thing as perfect lubrication, is when the moving parts, such as shafts and journals, are supported or floated on a film of oil which is of sufficient thickness to separate the bearing from the moving part under reasonable working loads and conditions. Pressure, speed, working temperature, condition of bearings and method of feed are factors determining the lubricant best fitted to the particular condition, but these phases of lubrication are also best left to specialists or experts, so they will not be treated in this article.

High pressure or heavy pressure bearings, but slow moving generally, require heavy lubricants; lubricants of high viscosities, as the pressure tends to squeeze the lubricant from the friction surfaces while fast moving bearings can be lubricated with light or thinner oils of less viscosity, because the fast moving shaft or journal, due to its speed, sucks or pulls the oil in between the moving part and the bearing and thereby aids in maintaining the oil film. In bearings that operate under high temperature conditions, such as electric motors, gas engines and the like, an excess of oil is quite often used. This tends to reduce the temperature of the oil film and thereby cools the bearing, producing a lower working temperature, which is desirable.

What has been said is an outline of the fundamentals of lubrication and while the writer is not going to attempt to select oils or lubricants for various places and conditions in quarrying operations, he does desire to give some general rules on

QUARRY LUBRICATION CHART

Machine	National Refining Co.	Sinclair Refining Co	Gulf Refining Co.
Air Compressors			
Air End, Single Stage	National Air Comp. Oil	Sinc. Gascon "A"	Harmony Air Comp. Oil
Air End, Multistage	National Air Comp. Oil	Sinc. Gascon "A"	Hercules " " "
Bearings	Nat'l. No 20 Engine "	Sinc. Commander Red Engine	Gulf American Red Engine Oil
Air Drills & Air Tools			
Dry Type	Nat'l. Pneumatic Lubr.	Sinc. Gascon "A"	Gulf Semi Fluid Oil Medium
Wet Type	" " "	" " "	" " "
Crushers - Jaw Type			
Pitman Bearings			
Oil Lubrication	Nat'l. Crusher Oil	Sinc. Heavy Red Engine Oil	Choctaw Red Engine Oil
Grease Lubrication	Enargo Cup Grease	Sinc. No 3 Cup Grease	Supreme Cup Grease No 3
Eccentries			
Oil Lubrication	Nat'l. Crusher Oil	Sinc. Heavy Red Engine Oil	Gulf Crusher Oil
Grease Lubrication	Enargo Cup Grease	Sinc. No 3 Cup Grease	Supreme Cup Grease No 3
Crushers - Gyratory Type			
Eccentric Bearings Cir. Type	Nat'l Heavy Engine Oil	Sinc. Red X Heavy Oil	Gulf Crusher Oil
Eccentric Brg. Non-Cir. Type	Nat'l Crusher Oil	Sinc. Crusher Oil	" " "
Grease Lubrication	Enargo Cup Grease	Sinc. No 3 Cup Grease	Supreme Cup Grease No 3
Suspension & Wearing Rings	Nat'l Heavy Engine Oil	Sinc. Crusher Oil	Gulf Crusher Oil
Bearings & Countershafts	Nat'l Red Engine	Sinc. Red Engine Heavy	" " "
Conveyors			
Plain Bearings.	Enargo Cup Grease	Sinc. No 3 Cup Grease	American Red Engine Oil
Ball Bearings	Natl. Ball Bearing Lubricant	Sinc. Semi Fluid Grease Medium	Supreme Cup Grease No 3
Pressure Gun.	Natl. Pressure Gun Grease	Sinc. Pressure System Grease	Gulf High Pressure Grease
Caterpillars, Steam Shovels & Cranes			
Grease Type	Enargo Cup Grease	Sinc. No 3 Cup Grease	Supreme Cup Grease No 3
Oil Type	Natl. Heavy Engine Oil	Sinc. Journal Oil "W"	American Red Engine Oil
Pressure Gun Type	Enargo Pressure Gun Grease	Sinc. Pressure System Grease	Gulf High Pressure Grease
Cars, Quarry			
Floating Axle Type	Natl. Car Journal Oil	Sinc. Semi Fluid Grease Medium	Gulf Mine Car Grease Heavy
Hollow Roller Bearing Type	Mine Car Roller Bearing Grease	" " "	" " " "
Solid Roller Bearing Type	" " " "	" " "	" " " "
Diesel Engines			
Cylinders	Natl. Diesel Engine Oil	Sinc. Rubilene Heavy	Gulf Diesel Engine Oil
Bearings	Natl. No2 Engine Oil	Sinc. Rubilene Medium	Sabine Engine Oil
Elevators			
Chain Type Oil Lubrication	Nat. Black Oil	Sinc. Journal Oil "W"	American Red Engine Oil
Chain Type Pressure Gun	Enargo Press. Gun Grease	Sinc. Press. Gun Grease	Gulf High Press. Grease
Engines - Steam			
Cylinders	Nat. W.S. Cyl. Oil	Sinc. No29 Spec. Valve Oil	XXX Cylinder Oil
Bearings	Nat. Red Engine	Sinc. Journal Oil "W"	Amer. Red Eng. Oil
Splash Lubricants	Nat. No 20 Eng. Oil	Sinc. Commander Red Engine Oil	No. 26 Splash Engine Oil
Engines - Gasoline-Kerosene			
Cylinders	Enargo Motor Oil	Sin. Rubilene Oil Medium	Supreme Motor Oil Heavy
Bearings	Nat. Red Engine	Sinc. " " "	" " Medium
Splash Lubrication	Enargo Motor Oil	" " " "	" " Heavy

Gears			
General in Oil Tight Housings.	National Gear Oil	Sinc.Trans. Oil	Gulf Trans. Lubricant
General Not in Oil Tight Housings	Natl.B.B.Gear Shield	Sinc.Onyx Heavy (Houston)	Gulf Lubricant
Exposed.	Natl. P & G. Spec Chield	" " "	" " H.S.
Hoists			
Bearings	Natl. Black Oil	Sinc.Journal Oil "W"	Sabine Engine Oil
Gears	Natl.Spec. P&G Shield	Sinc.Onyx Heavy (Houston)	Gulf Lubricant H.S.
Locomotives - Steam			
Cylinders	Natl.Loco.Valve Oil	Sinc.No 29 Spec. Valve Oil	XXX Cylinder Oil
Bearings	Natl.Loco.Engine Oil	Sinc.Journal Oil	Sabine Engine Oil
Journals	Natl.R.R.Journal Compound	" "W" "	Gulf Car Oil
General Purpose	Natl.Loco.Engine Oil	Sinc.Commander Red Engine	" " "
Locomotives - Gasoline			
Cylinders	Enargo Motor Oil	Sinc.Rubilene Med.	Supreme Motor Oil S.N.
Bearings	" " "	" " Medium	" " " "
Journals	Natl.Car Journal Oil	Sinc.Journal Oil "W"	Gulf Car Oil
Pressure Gun	Natl.Pressure Gun Grease	Sinc.Pressure Gun Grease	Gulf Car Oil
General Purpose	Natl.Loco.Engine Oil	Sinc.Commander Red Engine	" " "
Pumps - Water			
Centrifugal Type	Natl.No 20 Engine Oil	Sinc.Commander Red Engine	Amer.Red Engine Oil
Plunger Type	Natl.Heavy Engine Oil	" " "	" " " "
Screens - Rotary			
Ring Gear & Pinion	Natl.B.B.GearShield	Sinc.Onyx Heavy (Houston)	Gulf Lubricant Medium
Bearing Oil	Natl.Heavy Engine Oil	Sinc.Journal Oil "W"	Crusher Oil
Bearing Grease	Enargo Cup Grease	S. No.3 Cup Grease	Supreme Cup Grease No3
Pressure Gun	Enargo Press.Gun Grease	Sinc.Press.Gun Grease	Gulf High Press. Grease
Screens -Vibrating &Shaker			
Eccentrics	Natl.Heavy Engine Oil.	Sinc.Journal Oil "W"	Crusher Oil
Bearings & Guides	" " "	" " "	" "
Pressure Gun.	Enargo Press. Gun Grease	Sinc.Press.Gun Grease	Gulf High Press Grease
Starting Boxes			
Electric Controls	Natl. Switch Oil	Sinc.Switch Oil	Petrolatum Extra Amber
Steam Shovels & Cranes			
Steam Cylinders	Natl.W.S.Cyl. Oil	Sinc. No 29 Spec. Valve Oil	XXX Cylinder Oil
Gears, Chains	Natl. Gear Oil	Sinc.Onyx Heavy Lubricant	Gulf Lubricant H.S.
Grease Cups	Enargo Cup Grease	Sinc.No 3 Cup Grease	Supreme Cup No 3
Pressure Gun.	Enargo Pressure Gun Grease	Sinc. Pressure System Grease	Gulf High Pressure Grease
Bearings	Nat'l Heavy Engine Oil	Sinc. Journal Oil	Choctaw Red Engine
General Purpose Oil	National BlackOil	Sinc.Commander Red Engine	Choctaw Red Engine
Transformers			
Electric Outside Type	No 52 Trans. Oil	Sinc.Trans. Oil	L.V.Trans. Oil
Electric Inside Type	Natl.Trans. Oil	" " "	" " "
Thread Cutting Machines			
Cutting Oil Bolt & Pipe Machines.	No 2 Natl.Cutting Oil	Sinc. Sulphurette	Gulf Cutting Oil 1, 2 & 3
Well Drills			
Bearings	Natl.Heavy Eng.Oil	Sinc.Commander Red Engine	Choctaw Red Engine Oil
Gears	Natl.Spec. P & G Shield	Sinc.Onyx Heavy Lubricant	Gulf Lubricant H.S.
Wire Rope			
Lubricant	Natl.820 Cable Coating	Sinc.Onyx Heavy Lubricant	Gulf Lubricant Medium

this subject. However, bear in mind that there is no test or series of tests known that will actually guarantee the service of any oil under a given condition. In massive heavy pressure, slow moving machinery, such as large breaker or crusher heavy shafts, solid friction is as a rule the important factor in power consumption, while in ordinary bearings at normal speeds and pressure, fluid friction or power necessary to overcome resistance to oil, is the factor.

As a general thing, it is wise not to use heavy oils with high viscosity on high speed bearings as if results in poor lubrication and fluid resistance and viscosities higher than required result in a useless consumption of power. This mistake cannot be made in low speed bearings as high viscosity oils will then result in little if any fluid resistance or power loss. As oil or lubricant which does not prevent solid friction or wear, does not meet the primary requirements of a lubricant, as solid friction is a greater power eater than liquid friction. Grease as a lubricant is best suited for slow, heavy or intermittent loads; for lubricating parts of machinery whose bearings are improperly housed and inaccessible and to also prevent waste. In starting electric motors of large size or other big machines, which depend on an oil circulating system of some sort, it is often good practice to hand-oil them first before putting them in operation, especially if they have been out of service or standing idle a long time. In lubricating air tools, jack-hammer drills, air hammers, etc., when selecting an oil for lubrication give consideration to the extreme drop in temperature due to the expanding of the compressed air being used. The design, bearing material, and fit of bearings has a great influence on the quality and quantity of lubricant, so do not be too quick in condemning the lubricant when the trouble may be in the bearing. There is a mistaken idea that the gravity of gasoline is proof of its fitness for gasoline engines or motors. This is wrong, as gravity is no indication of quality of gasoline and is so considered by the U. S. Government experts.

The writer has a faint recollection of some one sending out a questionnaire relative to the subject of lubrication in the quarry and open pit mining industry. Whether the results or findings of this questionnaire were ever published I do not recall, but I am willing to give my experience and lubricating cost data if it will be of any help to the reader or to the industry.

The writer has always grouped oil, waste and grease under one heading, for cost keeping, and termed them Lubrication. By oil is meant all lubricating oils, kerosene and gasoline, but not kerosene or gasoline used for gasoline or kerosene engines or trucks, as this is considered and classified as Fuel or Power. Then taking lubrication as meaning oil, waste and grease, the cost per ton of stone produced for Lubrication runs from $.0033 to $.0073 per ton. A fair average would be ½ cent per ton. Oil or lubricants are often wasted and misused. For instance there is no limit to lubrication costs if reasonable care is not exercised in providing suitable storage, faucets, tanks, measures and containers for proper distribution. It does not pay to allow heads of barrels to be knocked in and oil bailed out with a can or bucket, neither does it pay to have leaky faucets or no faucets at all and attempt to draw oil directly from the bung of the barrel or drum.

The most satisfactory way of handling lubricants and oil is to make a contract for the entire requirement with a reliable oil company who can give tank wagon service or delivery. Put the entire problem up to them, let them furnish storage tanks and faucets and keep you absolutely supplied with every kind of oil and lubricant required. Give the oil company's tank wagon driver free access to the oil house and hold him, as well as the company, responsible for maintaining at all times adequate supplies of lubricants for the requirements in the oil house. You may wonder what advantage, if any, this will be: first, it will relieve your men from checking up and ordering a thing which can be easily overlooked, with the attending results, no lubricants to use; second, you eliminate, so far as your men are concerned the handling of all drums both filled and empty, and the records that should be kept of drum serial numbers; third, the matter of freight on filled tanks or drums, incoming and empties outgoing, is entirely eliminated, as the oil and lubricants are delivered in place in the oil house; fourth, the item of dryage or cartage, on incoming and outgoing drums, is entirely done away with. Therefore, tank wagon service is a money saver as far as the quarryman is concerned and it moreover is almost an absolute prevention to find that you are out of this or that kind of lubricant due to someone's failure to reorder. With the tank wagon driver the keeping of proper and adequate supplies is his one particular job and in many instances he works on a commission which makes you doubly sure of service.

As to misuse of lubricants we will only take time to mention one, although there are, no doubt, many similar cases. This example was the practice of one company using mineral castor oil in a large gyratory crusher. No one knew why they were using it, except that it was a huge piece of machinery, needed good lubrication, a machine they did not want to run hot or burn out, and a machine, which according to their own statement used lots of oil. Naturally it did use lots of oil of the kind, castor, they were using. Castor oil costing 34 cents a gallon was replaced by an oil costing from 35 cents to 41 cents and while the latter oil cost approximately 13 per cent more in price, it

required about 25 per cent less oil, meaning a saving and better lubrication, as castor oil was not suited for this work.

It is true that lubrication is a small item as far as cost of producing stone is concerned, but it is an essential item as machinery must be well lubricated to get results, and while it is a small item, it needs watching. It is the small leaks and petty costs that need checking as they are more apt to be overlooked than the bigger, more noticeable items. The little things go to make up the success of any business.

As to the right lubricant for the right place, every reliable oil company will gladly have their engineers, at your request, make a survey of the plant and operation and make a report of written recommendations as to the grade or kind of lubricant to be used under existing conditions. They will go farther than this, provided you contract with them for your lubrication consumption and follow through, watching performance of lubricants and conferring on the problem. These companies are sincere in their endeavor to satisfy, provide proper lubricants and cut costs wherever possible and as lubrication is a specialty, why not let specialists or experts handle it and hold them accountable for results, which is agreeable to them at no added expense to the quarryman.

Problems in the quarry and open pit mining industry are becoming more varied and complex, so much so that they are being dealt with by specialists and experts, and here is one thing, lubrication, provided we know the fundamentals, that we can and should be glad to turn over to some reliable oil company who are specialists in this particular line.

As a partial guide, however, to the quarry and open pit mining operator and executive, the writer has obtained from three reliable and representative oil companies, through their technical and practical men, lists of the lubricants by their trade names which these companies recommend for different places and uses in our particular industry. This data is presented in the form of a chart for quick and ready reference and should be interesting and valuable. The chart is given only as a guide in a condensed form, and is as near accurate as it is possible to get it in such form. It will be well to bear in mind not to take each recommendation literally as conditions materially alter cases of lubrication and as dust and grit are excessive in our industry, it is well to submit your lubrication problems to real specialists as outlined above. Lubrication of the proper sort, however, is another way or means open to the operator or executive to reduce production costs by lowering the cost of wear and tear; by lowering the cost of overcoming friction; and by lowering the cost of lubrication.

National Safety Council Holds Conference

The Quarry Safety Conference of the National Safety Council was held April 8, at the Secor Hotel, Toledo, with E. E. Evans, Whitehouse Stone Company, Toledo, Ohio, presiding as chairman. A considerable contingent of quarry men from the Middle West were present.

I. R. McClarren, safety agent, New York Central, Toledo, Ohio, spoke of the excellent work his company is doing in reducing accidents, attributing the amazing results to the fine co-operation between employer and employees. Constant education and good housekeeping also help, and one of the most important safety aids is the periodical examination of all workmen in the Book of Rules which must be passed on each examination with an average of at least 85 per cent.

D. W. Yambert, electrical engineer, France Stone Company, then gave a very interesting and constructive talk concerning electrical hazards. He closed by saying that the France organization was fitting individual motors with interlocking switches which automatically take care of the flow of material through the mill in case of break down or repairs of any sort.

E. R. Cartwright, MidWest Crushed Stone Company, presided at the afternoon session. After a movie of explosive engineering activities, produced through the courtesy of the Hercules Powder Company, J. Bader, Hercules Powder Company, Wilmington, Delaware, read a splendid paper called "Cost Reductions Through Accident Prevention." Jay E. Thompson followed Mr. Baber; he gave a demonstration of finger shut-offs for artery cuts and resuscitation, and asked that more attention be paid to demonstrating safety so as to establish customs automatically protecting employees from danger.

Costs of Building Apportioned

Labor consists of 62 per cent of the cost of building the average dwelling house while materials represent the balance of 38 per cent according to a study of construction costs made by the U. S. Department of Labor. These percentages differ with another newer study which allows labor 60 per cent of the cost and materials 40 per cent.

This new study credits the foundation and masonry with 36 per cent of the total cost of construction. The foundation is the largest single item representing 29 per cent including carpentry, labor and materials. Plumbing fixtures plus their cost of installation represent 10 per cent of the total. The heating plant represents 9 per cent. Hardware represents 8 per cent. Painting including materials represents 6 per cent. Lighting fixtures and their installation represent 2 per cent.

GERMAN CEMENT PROBLEMS DISCUSSED

THE Thirtieth General Meeting of the German Concrete Society took place at Berlin on March 17, 18, and 19. Delegations were present from Austria, Czecho-Slovakia and Sweden. The Chairman of the meeting was Dr. Ing. Hüser. Many papers detailing results of original research work were read and those of especial interest to Pit & Quarry readers are reported herewith:

The Behaviour of Mortar and Concrete at Low Temperatures[1]

Since the time of the war numerous experiments have been made in the "Materialprüfungsanstalt" of the Stuttgart Technical High School with mortar and concrete at low temperatures, partly with reference to technical problems, partly as research work.

In the first instance determination was made of the loss in strength shown by concrete when mixed at a temperature of 0 degree Cent. (32 Fahr.) and allowed to remain at same for a more or less protracted period of time. In this case attention was paid to the influence of different kinds of cements. It was found that the cements showed great variation in hardening at a low temperature. The largely prevalent idea that high grade cements are less efficient at low temperatures than ordinary cements has not found any support in the trials made up to the present. Furthermore, inquiry has been made, in regard to the extent to which retardation of the setting through an initially low temperature is to be taken into consideration in building construction. In the case of some cements a continuous diminution was observed, while with others the influence of the low temperature ceased to exert an apparent effect after a comparatively short time. In the third instance, investigation was made of the behaviour of mortars which had been mixed at ordinary temperature, but then allowed to freeze, corresponding to the treatment of concrete in shaft construction or similar work. In addition the influence of time as a factor from the pouring to the setting was followed. In all cases a considerable effect was to be noted in the case of low temperatures. Further, it was to be ascertained to what extent the influence of frost could be met with by the use of preparations in ordinary use. Three different kinds of anti-freezing preparations are available, the first is a calcium chloride solution, the second a magnesium chloride solution, and the third consists of calcium and sodium chlorides. The use of magnesium chloride proved to be quite unsafe. Calcium chloride at 18 degree Cent. (64.4 Fahr.) showed an increase in strength and at lower temperatures it showed a considerable increase in the strength. The action of calcium chloride at low temperatures was found to be more extensive than had hitherto been thought, but it will have to be determined by experiments, that is to say, after the addition of calcium chloride, whether the concrete attains the necessary strength. In the case of Haner Cement, the use of calcium chloride solution, is, however, not advantageous. In the course of further experiments, it was sought to ascertain the degree of strength required by concrete in order not to show scaling and cracks upon repeated freezing and thawing under water. As the result of the present investigations it is to be concluded that as a rule there is no retrogression of strength in case of freezing and thawing 25 times in succession, if the concrete before the action of the frost showed a compression strength of 100 kg. per cm.[2] If the thawing takes place without the addition of water, the danger of destruction is far smaller. Air-dried concrete stands freezing and thawing in the air, even when the strength is very low.

It is a fact of some interest that researches of this nature had not previously been carried out. They have been instigated by the coming into use of the freezing process, and by sub-aqueous constructions. It is known that all anti-freezing preparations so far on the whole are not entirely satisfactory, and it would be interesting to answer the question of the influence of calcium chloride upon dampness in dwelling house construction. Great care must be taken in dealing with this phase of the question. Great care on the whole, must be exercised in the employment of anti-freezing agents. Calcium chloride exerts a chemical action which varies highly with different cements. In the case of practical trials only a certain kind of cement was found suitable for use. Dr. Josten furthermore pointed out that quantity and mass are additional factors in the case.

Fused Aluminous Cement and Its Use in Reinforced Concrete Construction and in Stucco Work[2]

The municipal gas works of Hanover have, since 1921, been in the course of reconstruction and enlargement upon an extensive scale. In connection with the reinforced concrete construction selected, there have been used from 1925 on, also fused aluminous cement, namely Alka-Cement. In the aggregate, up to the present, about 300 tons of this has been used. Alka-Cement is produced by fusing together bauxite and lime at 1600 degrees Cent. (2912 Fahr.) in an electric furnace or in a fusion furnace, while Portland cement is produced, as is known, by fusing together lime and silicates in a rotary furnace. Accordingly it follows that the hydraulic mo-

[1] By Prof. O. Graf. Stuttgart.

[2] By Magistratsbaurat M. Orthaus, Hanover.

dulus of the two kinds of cement must differ. The setting in the case of Alka-Cement is normally somewhat shorter than in the case of Portland cements. What characterizes Alka-Cement, however, is the attaining of very high degrees of pressure resistance within a short time. Content of from 5 to 10 per cent of silicates is of importance on account of its influence upon the tensile strength. Accordingly the content of silica must be determined according to a minimum permissible amount. In the case of Alka-Cement, it is possible to remove the forms already in 18 to 24 hours, which is an important consideration in concrete construction, where any delay in the work would be inconvenient. Alka-Cement is superior to all other kinds in its resistance to chemical influences. It is, of course, taken for granted that it is susceptible to the action of free acids, but it shows good resistance to dilute salt solution, and to the attacks of furnace gases saturated with sulphur dioxide, and also to water containing carbon dioxide. Furthermore, Alka-Cement has shown itself to be possessed of good keeping qualities. After a period of storage in sheds for a year and a half it still showed good strength. The method of using Alka-Cement in concrete construction and the after-treatment of the concrete were dealt with. When used in stucco work, the Alka-Cement must be attenuated.

By means of numerous projections the extensive uses and possibilities of Alka-Cement were shown.

The Significance of Cement Stone in Poured Concrete[3]

According to the results of modern concrete research the quality of concrete depends chiefly upon the relative proportions of cement and water, in other words, upon the cement-water factor. The cement-water factor is produced by the mixture cement + water, and designated as neat cement mortar. The richer the neat cement mortar, the greater is the strength and density of the resultant cement stone.

Cement stone has two functions to fulfill in poured concrete. In the making up of the mixture it serves in the first instance as a lubricant promoting towards the liquefaction of the pouring concrete. Accordingly, there must be added to the cement an amount of water adequate to bring about a sufficient degree of fluidity. For this reason the cement content of the neat cement mortar, and consequently the quality of the cement stone in poured concrete, are limited.

The neat cement mortar by setting and hardening becomes a material binding the aggregate combining to give the concrete its properties.

By the pressing of cement stone cubes and the rupture of cement stone drawing bodies (without aggregate) it has been shown that cement stone becomes the strongest when about 18 parts by weight of water are taken to 100 parts by weight of cement. A mixture of cement and water, however, is not readily mobile until 36 parts by weight of water are taken to 100 parts by weight of ordinary cement. As long as the neat cement mortar is liquid the strength of the cement stone drops in direct line with the drop in cement content, i.e., with a falling cement-water factor. This is due to the fact that cement will combine with only about 16 parts of water chemically, the remainder remains uncombined in the water pores of the cement stone and makes it more or less porous.

In order to determine the significance of cement stone in poured concrete, there were made, simultaneously, cubes of neat cement mortar, and cubes with gravel and broken stone of varying fineness, using the same neat cement mortar, which after thorough hardening were pressed. The pressing results confirm the results of modern concrete research, the pressing strength of the concrete cubes after 28 days with same cement-water factor is almost the same as the pressing strength of the cement stone cubes.

The tensile strength of concrete is dependent upon the tensile strength of the cement stone and upon the degree of adhesion between the same and the aggregate.

The waterproof qualities of the concrete increase with the waterproof qualities of the cement stone, and these, again, in turn, with an increasing cement-water factor of the neat cement mortar.

The significance of the aggregate in concrete lies 1st, in that in the case of proper sizing it contributes essentially to the fluidity of the mixing, thus effecting a saving in cement, 2nd, that with proper selection as to size, the weight of the concrete can be increased, 3rd, that by a proper sizing the spacially non-stable cement stone in concrete can be reduced in amount.

A special norm sheet should be made out for each particular kind of cement, showing how the neat cement mortar must be made up, in order to attain a certain degree of strength.

Cubical Strength and Columnar Strength as Bases for Concrete Testing[4]

The abrasion of the surface of the edges obscures the results of the cube test by preventing the transverse bending on the surface by pressure, and by the same remaining plane, a kind of internal tension is occasioned. If this abrasion be prevented by the use of lubricants, such as stearine, or stearine and brass plates between body and lubricant layer, there is a drop in cubical strength in the case of cubes of a length of 7 cm. of edge to $W_0 = 0.5W$ as proven by experiments, and in case of columns (with $h:d = 3:1$) there is a decline in the columnar strength of $s = 0.80W$ to $S_0 = 0.6W$. In the case of slender columns ($h:d = 7.5:1$) the

[3] By Regierungsbaurat Guyo, Westseeminde.

[4] By Dr. Ing. W. Gehler, Dresden.

influence of this friction is completely lost, so that in this case $S_{min} = 0.7W$ is to be considered as the minimum value. Further trials with insertions of pasteboard and sheet metal of different thicknesses, as well as with cubes and cylinders of concrete furnish a contribution to the nature of friction of peripheric surfaces. If they are omitted the well known double pyramids are not formed, but in their place perpendicular cleavage surfaces parallel with the direction of pressure. In the case of bending tests on reinforced concrete beams the Poisson-number for concrete in the field of pressure was $m = 6$, in the field of traction, $m = 10$ to 12.

These results, as well as the well known trials of the German Commission, makes it possible to fix the Nohr limit curve for concrete (and particularly for the ordinary, reinforced concrete mixing), for the first time, as an invariable property of this building material, in case of which all values in H.T. of $W_{28} =$ are given. Some results: The tractile strength is $0.09\ W = \frac{1}{11}\ W$, the torsional strength = tractile strength, to be so accepted. The torsional test offers the most dependable values for tractile strength in case of concrete. The circle of tension $S_0 = 0.6$ W and the tractile strength confine the limit curves within the tractile reach. The tamping strength is 0.23W. From these elements of the limit curve and the measured superficial inclinations, it follows that the circle of tension of the cubical strength W through the R point goes towards the system 6-J and coincides with the flexional pressure strength (flexional pressure strength = W.). The results of computations of two dissertations of 1926 (by W. Riedel, Göttingen, and M. Knein Aschen), furnish in connection with the works on the theory of plasticity by L. Prandtl, H. Henecky, and A. Nadei, enlightenment upon the complicated tensional relations in pressure cubes, especially on the unfavorable influence of edges and corners.

The safety of concrete in reinforced construction, can after the Mohr limit curve has been obtained, be estimated within the limits of pressure, for example immediately upon the removal of the forms in the case of reinforced column construction in the case of commercial cement, in the case of high-grade cement, especially, also, in the case of complicated pourings, however, only, in cases where there is an even distribution of tension. A new method taking into consideration the trials of R. Böker and W. Rode and proposed by R. Girtler, H. V. Mieses, and F. Schleicher, is founded upon the energy limits of the elasticity (condition of plasticity) and allows the taking into consideration of all tensions. The resultant work of change of form, that is to say, the ending of a particle of matter in the moment of the formation of the level area is computed according to the experiments, and furnishes a new limit line, which, here, again fixes the permanent characteristics of the material and can be used for the estimation of the safety.

As a result of the experiments it is quite possible to form a picture of the tensional relations in cubes. In a certain sense the experiments in relation to the contention between the cube and the column, tend to favor that of the cube. Further experiments are required in order to determine whether the advantages offered by the column are sufficiently great to warrant general introduction.

Approved Mining Equipment

A list of permissible mining equipment approved by the United States Bureau of Mines, Department of Commerce, up to and including January 1, 1927, has recently been published. The list covers electric air compressors, coal drills, mining machines, loading machines, conveyors, mine pumps, room hoists, rock-dusting machines, switches, electric cap lamps, flame safety lamps, electric hand and trip lamps, flash lamp, methane indicators and detectors, blasting units, storage-battery locomotives, power trucks, self-contained oxygen breathing apparatus, and gas masks.

The system under which these devices were tested permits the manufacturer, after his equipment has passed certain tests prescribed by the Bureau of Mines, to mark his equipment with a seal showing that it has been "approved" by the Bureau. These tests are designed to insure that the equipment has the minimum requirements for safety in use. The only object of the Bureau in making such tests and publishing lists of permissible equipment is to safeguard the lives of workers and to help lessen the hazards of mining.

Average Interest Rate 3.87 Per Cent for Savings Account

Savings accounts in banks throughout the United States earn as an average 3.87 per cent per year for the depositors, according to data collected by the Comptroller of the Currency. The records show the average prevailing rates of interest paid on savings accounts in each state. The average rates in the Northwest are the highest. The highest average rate is 4.40 per cent and is for North Dakota. Montana averages 4.30 per cent, South Dakota 4.20 per cent, Iowa 4.14 per cent, South Carolina 4.33 per cent, Georgia 4.16 per cent, Kentucky 4.10 per cent, Massachusetts 4.06 per cent, New Mexico 4.09 per cent, New York 3.94 per cent, Pennsylvania 3.49 per cent, Illinois 3.42 per cent, Wisconsin, 3.34 per cent, and Maryland 3.04 per cent. Fifteen states pay an even 4 per cent. The lowest rate is paid in Maryland and is 3.04 per cent.

CHARACTERISTICS OF PORTLAND CEMENT AND THE NATURE OF THE BURNING PROCESS

By Dipl.-Ing. E. Ullrich*

PROPERTIES of portland cement are chiefly due to: (1) Chemical and physical condition of the raw materials and their preparations. (2) The nature of the burning process. (3) The subsequent working up of the clinker into cement.

The large amount of research which has been carried out on this subject has resulted in the satisfactory clearing up of the problems of the first and last cases, so that in regard to these points the problem can be considered practically as solved. But in regard to the second, the influence of the burning process much uncertainty still prevails.

In modern cement production, as a known fact the more practical modern shaft kiln in spite of outturn of a for the most part inferior product, has an advantage over the less productive rotary kiln, though the latter produces a perfect, high grade clinker. The utilizable ranges of temperature attained in both types of kilns are approximately the same, the material can be brought to the sintered stage in the shaft kiln equally as well as in the rotary kiln. The length of the burning, however, is very different in the two types of kilns. The slow getting up of the temperature, the long time consumed in the burning, and the slow cooling of the shaft kiln are in marked opposition to the working of the rotary kiln with its rapid getting up of the temperature, the short time of the burning process, and the subsequent rapid cooling. From these facts, found in actual practice, the great influence of the burning process becomes apparent.

In order to obtain a proper recognition of these facts, the most simple procedure would be to obtain the data on temperature, duration of burning, and rapidity of cooling, the measurement of these, and the making of trial runs in which they are varied, and ascertaining the properties of the resulting cements. The possibility of following the burning temperature of the total clinker charge and the duration of the burning, becomes possible, however, with a degree of certainity only in the smallest of kilns and with the smallest charges of raw material. In this case, again, it is impracticable to make any tensile strength test on such resulting cements, as the amount required is more than that produced in such a burning. Even should it be possible to obtain sufficient material a single tensile strength test would not be sufficient to furnish any quantitative data. The study of the direct influence of the burning on the quality of cement becomes feasible only through the possibility of quantitative tensile strength determinations on amounts of cement of from 20 to 30 grams. This has recently been accomplished by Kühl by means of his micro-testing method* which will be described later.

Now it is practicable to carry out burnings in the electric kiln, and to carefully follow the variations in burning temperature, duration, and rapidity of cooling, the resulting clinker being powdered and then tested for flexional strength according to Kühl's method.

Inasmuch as, formerly, these means were lacking, it was possible to draw from the work carried out on the constitution of portland cement clinker, only indirect conclusions as to the influence of the burning. If the compounds occuring in clinker possessed of hydraulic setting properties and their methods of formation are known, it becomes possible to constitute a material and carry out a burning process resulting on the whole in the production of a good clinker.

As is known, portland cement consists of CaO, SiO_2, Al_2O_3, and Fe_2O_3, as the chief constituents with which small amounts of MgO, SO_3, and alkalies are associated, which latter, however, are of subordinate importance as far as its properties are concerned. The first mentioned constituents as such, in themselves, are not capable of forming a cement with setting properties, it is only as the result of chemical action taking place upon heating, temperatures of from 1400 to 1450 Cent. (2552-2642 Fahr.) being used in practice, that the resulting product acquires cement properties.

If it be considered that Fe_2O_3 together with Al_2O_3, present for the most part only in small amounts closely resemble each other in chemical properties it becomes evident that portland cement must closely approximate the three-ingredient system $CaO—SiO_2—Al_2O_3$. The study of this system accordingly occupied most past research.

In the phase diagram of the three-ingredient system Calcium oxide, Silicon dioxide, and Aluminum oxide, the portland cement, according to its composition is near to the calcium oxide limit and according to the American researches in reference to crystalline form to the compounds $3CaO.SiO_2$, $2CaO.SiO_2$, and $SCaO.Al_2O_3$[1]. Jänicke[2] is of a

*From "Zement und Zementverarbeitung," Feb. 3, 1927.

*Zeitschr. "Zement," 1926.

[1] E. S. Shepherd, G. A. Rankin u. F. E. Wright. Zeitschr. f. anorg. Chemie, Bd. 71, S. 19, (1911).

[2] E. Jänecke, Zeitschr. f. anorg. Chemie, Bd. 73, S. 200 (1911). Zementprot. 1912, S. 249 and 1913, S. 273.

different opinion and considers the existence of $3CaO.SiO_2$ as doubtful and proposes in place of it a compound $8CaO.2SiO_2.Al_2O_3$. Accordingly the problem would be solved in one sense or other if portland cement were in a system of fusional equilibrium. But that this is not the case is shown by the fact that it is only heated to the sintering and not to the fusing point. If the fixing of an equilibrium is difficult already in a melted down silicate mixture, it must evidently be practically impossible in the case of a partial fusion.

Now the formation of the compounds mentioned from the ingredients takes place in part already in the first phase when their tendency to react is adequately increased. This takes place, first, by strongly heating, second, by the presence of calcium oxide in the form of calcium carbonate, and of silicon dioxide and alumina as clay in the mixture. Now, according to Tamman and Pape, clay decomposes into its constituents at about 700 Cent. (1292 Fahr.), and at 900 Cent. (1652 Fahr.) calcium carbonate gives off carbon dioxide, it will be seen that the three chief components are present in the form of highly reactive chemical compounds.

Furthermore, the reactions when once started are of such an exothermic nature that they can often be recognized by the side of one another by the thermochemical analysis.

It is upon this method in conjunction with the optical examination of the product obtained that the especially important results achieved by the extensive researches of Nacken and Dyckerhoff are based, which are of especial importance in modern phases of this subject*.

The ultimate results of these researches, as well as those of all investigators up to the present is evident from the following:

In thin slides of the most different kinds of clinker certain definite crystals are invariably met with. The same were discovered by Le Chatelier[1] and Törnebohm[2] independently of one another, and designated by Törnebohm, as Alit, Belit, Celit, and Felit, a designation which has remained in use until the present. Further, Glasenapp[3] recognized in Belit and Celit two varieties of the same crystals, Celit-b and Celit-a and in addition, discovered a new sonstituent to which he, instead, applied the name Belit. Furthermore, he succeeded in characterizing the crystals in a more satisfactory manner, and above all to prove that Alit was the constituent possessed of the actual hydraulic or setting properties. It must be especially emphasized that the optical properties of the Alit vary within certain degrees according to the nature of the clinker.

The optical properties of Alit are the following:
Refraction: strong.
Double refraction: weak.
Extinction: straight.
Rhombic.
Postive. However, doubtful, even the most careful investigators make no statement in regard to the optical characters.

From now on it was the chemical composition and the manner of formation of this mineral which claimed the greater part of attention of the more recent portland cement researches.

Nacken and Dyckerhoff had already had predecessors in Meyer[4] Tschernobaeff[5] and in Dittler and Jesser[6], these also, had striven to fix by themochemical means the clinker formation from raw material. Their work, can, however, be considered as having been surpassed by the two first-mentioned investigators.

In the following I will give a brief review of the comprehensive work of Nacken and Dyckerhoff.

Their principle was to heat at a temperature below the fusing point up to about 1500 degrees Cent. (2732 degrees Fahr.) and to recognize the compounds and their method of formation in the corresponding two and three material systems, to study their thermochemical effects, and to prove their presence by means of themoanalysis in the clinker formed from technical raw material. As far as possible, to prove the presence of the compounds, microscopically in clinker.

They found that as far as portland cement clinker was concerned the following compounds to come under consideration:

$2CaO.SiO_2$; $3CaO.SiO_2$;
$CaO.Al_2O_3$; $3CaO.Al_2O_3$; $5CaO.3Al_2O_3$;
$8CaO.2SiO_2.Al_2O_3$.

The compounds $3CaO.SiO_2$ and $8CaO.2SiO_2.Al_2O_3$ have been proven with certainty to be present. Formerly their existence had been in doubt.

The properties and conditions of formation are given as follows:

Compound $2CaO.SiO_2$:
Exists in three forms: α—, β—, γ-$2CaO.SiO_2$.
Properties of α-$2CaO.SiO_2$:

Melting point: 2130 degree Cent. (3866 degrees Fahr.).
Refraction of light: 1.717-1.735,
Double refraction: 0.016,
Longish prisms, rhombic or monoclinic,

*Nacken: Ueber die beim Erhitzen von Zement vor sich gehender Reaktionen. "Zement," 1920, S. 61. Ueber die beim Erhitzen von Zementrohmehlen vor sich gehender Reaktionen. "Zement," 1921, S. 246. Thermochemische Untersuchungen am Zementrohmehl und am Zement. "Zement," 1922, S. 245.
Dickerhoff: Was ist Alit? "Zement," 1924, S. 455.
Nacken und Dyckerhoff: Ueber den Verlauf der Mineralbildung beim Erhitzen von Gemengen aus Kalk, Kiselsäure und Tonerde. "Zement," 1924. S. 626.
Dyckerhoff: Ueber den Verlauf der Mineralbildung beim Erhitzen von Gemengen aus Kalk, Kieselsäure und Tonerde. "Zement," 1924, S. 681. Ueber Bildung und Eigenschaften der Kalziumsilikate. "Zement," 1925, S. 3. Ueber Bildung und Eigenschaften der Calciumaluminate, "Zement," 1925, S. 60. Ueber die Verbindung $8CaO.2SiO_2.Al_2O_3$. "Zement," 1925, S. 102. Einige Beobachtungen an basischen Gemengen aus Kalk, Kieselsäure und Tonerde. "Zement," 1925, S. 140. Die Vorgänge beim Brennen synthetischer Rohmehle. "Zement," 1925, S. 174. Ueber die Vorgänge beim Brennen von Zementrohmehlen. "Zement," 1925, S. 200.

[1] Le Chatelier: Researches experimentales, S. 63.
[2] Törnebohm: Die Petrographie des Portlandzementes.
[3] M. V. Glasenapp: Zement-Prot. 1913 S. 313.
[4] Zementprot. 1897, S. 151.
[5] Tonindustrie-Zeitung 1895, S. 324.
[6] L. Jesser, Zentral bl. f. Chem. u. Anal. h. hyhr. Zemente, 1911, S. 1 ff. und 5, 65 ff. E. Dittler und L. Jesser eben das, 1910, S. 71.

straight dissolution,
positive,
specific gravity: 3.28
sets hydraulically.

Properties of β-2CaO.SiO,

Transition point α—β: 140 degrees Cent. (sharp transition).

Double refraction: 0.022.

In other properties it agrees with the α-compound. No appreciable difference in the specific gravity. No change in structure during transition, hydraulically setting.

The α- and β-modifications have the property to take excess lime up to 10 per cent in solid solution.

Properties of $2CaO.SiO_2$:

Transition point β—γ: 675 Cent. (1247 Fahr.) (Slow transition.)

Refraction of light: 1.645,
Double refraction: 0.015,
Monoclinic (not certain),
Strongly marked striation,
negative,
Specific gravity: 2.974,
Hydraulically completely inactive.

It is due to the difference in specific gravity between the β- and γ- forms of $2CaO.SiO_2$ that many clinkers disintegrate, the γ- form occupying a greater space than the β- form.

Conditions of formation: formation takes place from the components at 1050 degrees Cent. (1922 degrees Fahr.). Its presence can be proved after 17 hours. Rapid formation with distinct exothermic reaction between 1100 degrees and 1200 degrees Cent. (2282 degrees and 2192 degrees Fahr.).

While pure $2CaO.SiO_2$ invariably disintegrates on cooling the introduction of an aluminate renders it stable.

Properties of $3CaO.SiO_2$:

Melting point: not determined, decomposes at 1900 Cent. (3452 Fahr.) into CaO and $2CaO.SiO_2$,
Refraction of light: 1.715,
Double refraction: 0.005,
Prisms; monoclinic or triclinic;
Negative;
Specific gravity: 3.25,
Hydraulically setting, rapidly binding and expanding.

Conditions of formation: In a mixture $3CaO+1SiO_2$ there is first off formed at the temperatures given $2CaO.SiO_2$. The reaction $2CaO.SiO_2+CaO$ does not occur with any appreciable rapidity until 1500 degrees to 1600 degrees Cent. (2732 degrees to 2912 degrees Fahr.).

In an aluminate fusion the formation does not take place either below 1450 Cent. (2642 Fahr.).

All lime-silica mixtures react primarily according to $2CaO.SiO_2$.

It is only subsequently that the corresponding equilibrium is entered upon.

The compounds $CaO.Al_2O_3$, $3CaO.Al_2O_3$, and $5CaO.3Al_2O_3$.

The optical properties of these compounds are only of subordinate importance. They are formed from mixtures of the corresponding composition on heating, after the initial formation of $CaO.Al_2O_3$. The formation temperature for $CaO.Al_2O_3$ is from 900 to 1000 Cent. (1652 to 1832 Fahr.). That for $3CaO.Al_2O_3$ is between 1300 and 1400 Cent. (2372 to 1652 Fahr.). The compound $5CaO.3Al_2O_3$ is formed at the same temperatures as the preceeding one. The eutectic of $3CaO.Al_2O_3$ and $5CaO.3Al_2O_3$ melts at 1395 Cent. (2542 Fahr.).

Properties of compound $8CaO.2SiO_2.Al_2O_3$:

Melting point: cannot be determined, commences to sinter together at about 1900 cent. (3452 Fahr.).

Refraction of light: 1.705,
Double refraction: 0.004,
Fine needles of crystals; monoclinic?
Negative,
Hyraulic setting properties, moderate only; by far less than those of portland cement.

Conditions of formation. Is formed from mixtures of the pure components at temperatures not below 1800 Cent. (3272 Fahr.). This compound was first discovered and described by Jänecke*.

In addition to the mineral examinations made, the heat curves of different technical and synthetic raw materials were obtained. The term "synthetic raw material" as used by Nacken and Dyckerhoff is applied to mixtures consisting only of calcium oxide, silicon dioxide, and alumina, in approximately the proportions constituting portland cement.

Technical Raw Material

See figure 1. Below 900 Cent. the curves show but slight deviation, loss of water, etc. At 900 Cent. the distinctly endothermic effect of the carbon dioxide splitting off became apparent as shown by the diagram. The subsequently following sharp rise of the crucible curve and the exceeding of the furnace temperature at about 1270 Cent. indicates the taking place of a powerful exothermic reaction caused by the chemical transitions of the raw material. These reactions are terminated at about 1280 Cent. by a partial endothermic fusion. The reactions as well as the static points took place with a remarkable constancy in portland cement raw material of the most varying composition, so that one is entitled to the conclusion that the fusions and the reactions involved are similar. The cooling curve shows a solidifying point corresponding to the melting point at 1215 Cent., accordingly with a drop of about 60 Cent. Between 1280 and

*E. Jänecke, Zeitschr. f. anorg. Chem., Bd. 73, S. 212 ff. (1911). Zementprot. 1912, S. 264 ff., also 1913, S. 283 ff.

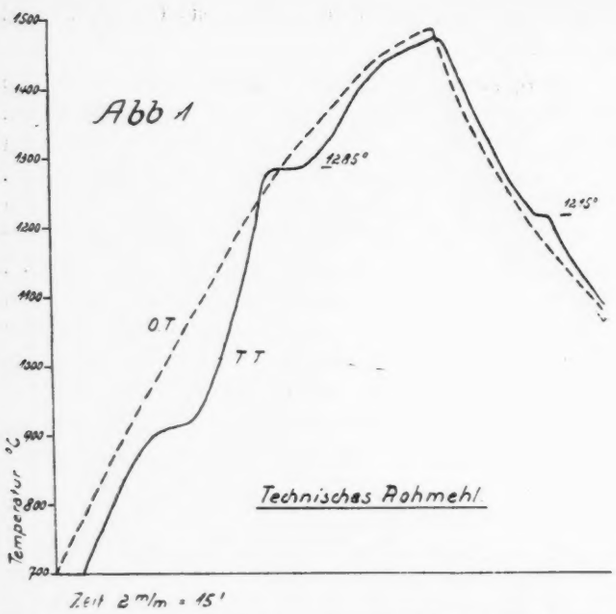


Figure 1. Thermochemical examination of technical raw material according to Dyckerhoff. O. T. = Oven Temperature. T. T. = Temperature of Brick.

1500 Cent. no further reactions made themselves evident.

A synthetic raw material showed curves of the same character. See figure 2.

While here the exothermic reaction takes place at the same temperature as in case of technical raw material, fusion does not take place until about 1390 Cent. (2534 Fahr.). In this case also a great regularity in the melting point is noticeable and the fact that the eutectic of $3CaO.Al_2O_3$ and $5CaO.Al_2O_3$ melts at 1395 Cent. (2543 Fahr.) makes it that the partial fusion takes place at the same or a similar temperature. The cooling curve again showed the corresponding effect with a drop at 1350 Cent. (2462 Fahr.). The known fact that ferric oxide facilitates the sintering is clearly evident from that the melting temperature of the residual mass of iron-free raw material is about 100 Cent. higher than in the case of raw material containing iron. The clinker from synthetic raw material sintered at 1500 Cent. (2732 Fahr.) for 20 minutes was disintegrated on the surface and in thin section showed:

1. About 60 per cent of $CaO.SiO_2$, mostly of the β- variety containing about 10 per cent CaO in solid solution.
2. $3CaO.Al_2O_3$.
3. $5CaO.3Al_2O_3$.
4. Small amount of free lime.

Under the heat microscope a powerful contraction of the raw material was observed at 1280 Cent. (2336 Fahr.) and 1380 Cent. (2516 Fahr.) respectively, occasioned by the partial fusion. The exothermic effect in the case of the raw material is covered by the effect of the formation of $CaO.Al_2O_3$, (900-1000 Cent.) and $2CaO.SiO_2$, (1050 Cent.) In the opinion of Dyckerhoff it is the aluminate fusion which prevents the disintegration of

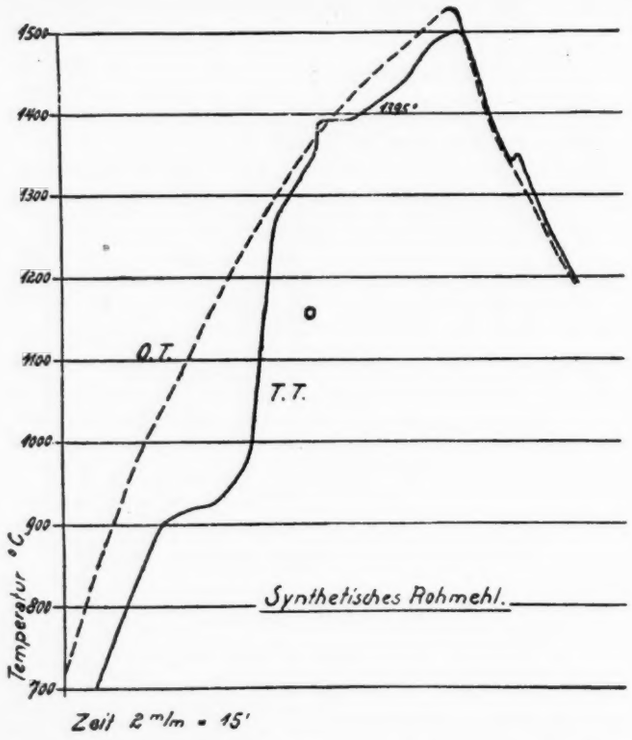


Figure 2. Thermochemical examination of synthetic raw material according to Dyckerhoff. O. T. = Oven Temperature. T. T. = Temperature of Brick.

the di calcium silicate by surrounding it with a solid rind making the expansion of the individual particles setting in at 675 Cent. due to the transformation of the β-form into the γ-form, impossible.

In the case of technical raw material it can be observed that before the fusion takes place at 1280 Cent,. a light burnt yellow product, above this temperature the clinker was strongly sintered and of a dark color.

Fused clinker contains about 90 per cent of $8CaO.2SiO_2.Al_2O_3$, the presence of which could not be proved in normally burnt material. Accordingly up to the melting temperature the silicates and the aluminates must be present separately or uncombined.

The composition of the residual fusion was computed by subtraction of 60 per cent ($2CaO.SiO_2$ + 10 per cent of CaO) from the cement analysis.

Dyckerhoff formulates the result of the work as follows:

The changes taking place in the burning of cement is the same in the case of all portland cement raw materials.

1. Heating

At 700-800 Cent. (1292-1472 Fahr.) Decomposition of the clay into Al_2O_3 and SiO_2.

At 910 Cent. (1670 Fahr.) Decomposition of the calcium carbonate into carbon dioxide and lime.

At 1000 Cent. (1832 Fahr) Formation of $CaO.Al_2O_3$. Probably also compounds of calcium and ferric oxides.

At 1100-1200 Cent. (2932-2192 Fahr.) The compound β-2CaO.SiO_2 is formed.

At higher temperatures 2CaO.SiO_2 takes up about 10 per cent of calcium oxide from the residual melt.

Within the range of the temperatures in practical use there is no further occurrence of a final equalibrium as between 1300 and 1500 Cent. (2372 and 2732 Fahr.) no further thermal effects could be observed.

2. Cooling

At 1215 Cent. (2219 Fahr.) Solidification of residual melt. The transition of the β-2CaO.SiO_2 into its γ- form which really takes place at 675 Cent. (1247 Fahr.) does not occur here as the fusion coats the crystals solidly.

Above all, Nacken and Dyckerhoff assume that the Alit β-2CaO.SiO_2 is in solid solution with about 10 per cent calcium oxide inasmuch as its optical properties scarcely differ from those of the compound.

No matter how convincing the theory just explained may be, there are, however, several factors against it. Chief of these are the opinions of Kühl which in their essential points can not be reconciled with the same. Kühl supports his claims by his own results gained in scientific research and in actual practice as well as by those of other investigators.

The following facts, chiefly, speak against the Nacken-Dyckerhoff theory:

1. If 2CaO.SiO_2 with about 10 per cent of dissolved CaO, together with the calcium aluminates even of the highest CaO content, there is still some 10 per cent of CaO which is not accounted for, which accordingly would be recognizable in a free condition in every portland cement clinker. This is, however, at the most the case, and even then, not always, the case of portland cements close to the transition limit[1].

2. The fact that already a small addition of alumina (four per cent)[2], prevents the disintegration of the 2CaO.SiO_2, depends, rather, upon a chemical transition of the di calcium silicate, as it is difficult to conceive that such a thin fusion film should compensate the enormous pressure of the crystal transformation[3].

3. Free aluminates with more than 1CaO to 1Al_2O_3 in their stable forms crystallize in the regular system. Inasmuch, as, however, regular crystals have hardly been observed in portland cement clinker, the clinker can not contain any free aluminates[4]. In addition, they are in so far as they are possessed of hydraulic properties, of rapidly binding properties which accordingly they must impart to the cements as well.

4. As the results of trials involving the rotary kiln, Kühl has showed that it is first at temperatures of from 1340 to 1350 Cent. (2444 to 2462 Fahr.) that a clinker results having the aggregate of characteristics which constitute portland cement clinker, such as a normal setting and other characteristics of a normal cement, as well as the characteristic dark grayish green color[1].

5. While β-2CaO.SiO_2 may be possessed of hydaulic setting properties these are, however, far less pronounced than those of portland cement[2].

6. It is not possible to account for an increase in the amount of Alit in the clinker with the increase in CaO. As the solubility of CaO in β-2CaO.SiO_2 is limited and accordingly the CaO must find its way into the fusion, there would result with an increase in CaO an increase in the quantity of the melt but not in that of the Alit.

7. The positive character of Alit has not been proven with such certainty so as to furnish a basis for assuming its similarity with the β-di calcium silicate. The other optical constants of Alit are only known in so slightly defined a formed that one could be equally well justified in comparing them with those tri calcium silicate and those of Jäneckit, as with those of di calcium silicate.

These are the chief arguments against the acceptance of β-di calcium silicate as Alit. In the following will be dealt with facts upon which another theory for the formation of clinker is founded.

Of all the binary compounds of the three-material system lime-silica-alumina there is no one which comes under consideration as a chief constituent of portland cement clinker, as no one of them possesses even in a remote degree in their hydraulic properties any similarity to cement. Even though they may possess, as do a number of the aluminates, in fact, good hardening properties, they are, however, of an expansive or rapidly setting nature on which plaster or water, hardly exert their regulative influence[3].

If, then ternary compounds must be accepted, it has, however, been shown that these, also, can not come under consideration[1]. As the only one, perhaps, to be considered, would be the compound 8CaO.2SiO_2.Al_2O_3 discovered by Jänecke, which as a matter of fact has been identified amongst the product of the sintering of the mixture composed of the impure ingredients[2]. As, however, it is too low in calcium and too high in Alumina, and, furthermore is possessed of only moderate hardening properties, it, too is eliminated from consideration. Other ternary compounds, in so far as they lie close to the portland cement field in the phase diagram, have not been proven to be present with any satisfactory degree of certainty, so that it is difficult not to accept the supposition that pure and definite

[1] Was ist Alit? Kühl, "Zement," 1924, S. 512.
[2] Schott, Kalksilikate und Kalkaluminate, S. 103.
[3] Kühl, Zementprot. 1924, S. 191.
[4] Was ist Alit? Kühl, "Zement," 1924, S. 454.

[1] Kühl, Feuerschwindung und Sinterung als Stufen des Garbrandes. "Zement," 1922, S. 454.
[2] Schott, Kalksilikate und Kalkaluminate, S. 87 und 111.
[3] Kühl und Knothe, Die Chemie d. hydr. Bindemittel, S. 155 und 156.

chief compounds are not to be found in portland cement clinker.

Now, Dittler and Herold by fusing together $3CaO.Al_2O_3$ with $2CaO.SiO_2$. and $CaO.SiO_2$ obtained optically homogenous products with setting properties similar to those of portland cement[3]. Schott was able to obtain by the addition of four per cent of alumina to a mixture of the components in the requisite proportions, a stable product which showed only slight optical deviations from tri calcium silicate[3]. He proved that during the burning a double decomposition takes places between aluminates and silicates, by making a mixture of 4 parts of the fusion product of $2.5CaO + lSiO_2$ with one part of the product of $2.5CaO + lAl_2O_3$ and determining the tensile strength—28 kg. per sqare cm. after 28 days of immersion. The same mixture termining the tensile strength—28 kg. per square cm[4]. Finally, it has been shown, as the result of many other experiments, that in the series Calcium silicate-Calcium aluminum silicate-Calcium aluminate, that the intermediate members are possessed of the best strength and at the same time have a faultless constancy of volume[5].

The fact that already at about 1000 Cent. and upwards new compounds are formed from $CaCO_3 + SiO_2 + Al_2O_3$ may be considered as proved, the lime reacts as such already at the temperature of the gas blow pipe breaking up the alumina and the silica in such mixtures.

Furthermore, the researches of Wetzel[6] shows that the composition of the fusion changes at least up to 1400 Cent. He found that upon the cooling of highly heated raw materials there were inhibition points which were increasingly lower the higher the raw material had been heated previously. If it were heated to above 1400 Cent., there were no longer any appreciable divergencies in the point of inhibition. The simplest structure was shown by clinker of the composition of the type $3CaO.SiO_2$—$2CaO.Al_2O_3$. The fact that only here a crystalline formation is met with can be accounted for by assuming a combination or a solid solution of both. The theory of Kühl of the formation of clinker as based on these premises can be briefly outlined as follows:

At about 500 Cent. (932 Fahr.) Loss of the water from the clay.

At about 700-800 Cent. (1292-1472 Fahr.). Decomposition of the clay into Al_2O_3 and SiO_2.

At about 900 Cent. (1652 Fahr.). The limestone loses its CO_2.

Above 900 Cent. (1652 Fahr.). Reactions between CaO on the one hand and SiO_2, Al_2O_3, and Fe_2O_3 on the other hand which at about 1350 Cent. (2462 Fahr.) are to a certain extent finished, a formation having been brought about by a conversion of the various silicates and aluminates of a low lime content into solid solutions or isomorphous mixtures of compounds of a higher lime content, which are to be considered as the carriers of the hydraulic hardening properties of the portland cement.

In any case, however, it is only from this temperature and up that a clinker of any sort of utilizable properties results[1].

The reactions which lead to the production of a good technical product are favored by a partial fusion. In any case, however, they continue at beyond 1400 Cent. (2552 Fahr.), as sharply burnt clinker exhibits a better quality.

In accordance with the changing habitus of the Alit the chief minerals of portland cement must be considered as solid solutions of a highly basic calcium silicate and calcium aluminate, which with the diminuition of the Al_2O_3 in the clinker, approaches calcium tri silicate. Very likely, tri calcium silicate saturated with $8CaO.2SiO_2.Al_2O_3$ is under consideration.[2] The reaction takes place both in the solid and the liquid phases.

The influence of the rapidity of the cooling, according to Kühl showed itself to be irregular in such a manner that it was not possible to arrive at any conclusive data by means of any available means.

Even though these theories do not offer any direct evidence as to the influence of burning temperature, duration of burning, or rapidity of cooling, there are, however, a number of points to be deduced from them. It is evident that by considering either the one or the other of the theories the results must differ.

According to the Nacken-Dyckerhoff theory it follows:

1. That all clinker burnt below 1270 Cent. (2318 Fahr.) must disintegrate as the result of the absence of the residual melt.

2. From the point on, at which the saturation of the β-di calcium silicate with CaO is completed, or in other words, after a sintering for about 20 minutes at about 1350 to 1400 Cent. (2462 to 2552 Fahr.) the fastness must remain the same also after heating to a higher temperature and for a longer period of time.

3. A greater rapidity of cooling must increase the fastness.

4. Outside of a slight increase in density there should, from 1300 Cent. (2372 Fahr.) on with an increasing burning temperature, be no change in the appearance of the clinker. An increase in the melt could by no possible means be explained.

On the other hand the following become evident from Kühl's theory:

(Continued on page 80)

[1] Kühl und Knothe, Die Chemie d. hydr. Bindemittel, S. 141.
[2] S. 139.
[3] S. 134.
[4] S. 135.
[5] S. 136.
[6] S. 347 ff.
[6] Wetzel, Zementprot. 1911, S. 262 ff. 1912, S. 219 ff. 1913, S. 347 ff.

[1] Kühl, Feuerschwindung und Sinterung als Stufen des Garbrandes. "Zement," 1922, S. 454.
[2] Kühl, Tonindustrie-Zeitung, 1914, S. 365.

JOSEPH McCORMICK PRODUCES MATERIAL WITH A MINIMUM COST

By F. A. Westbrook

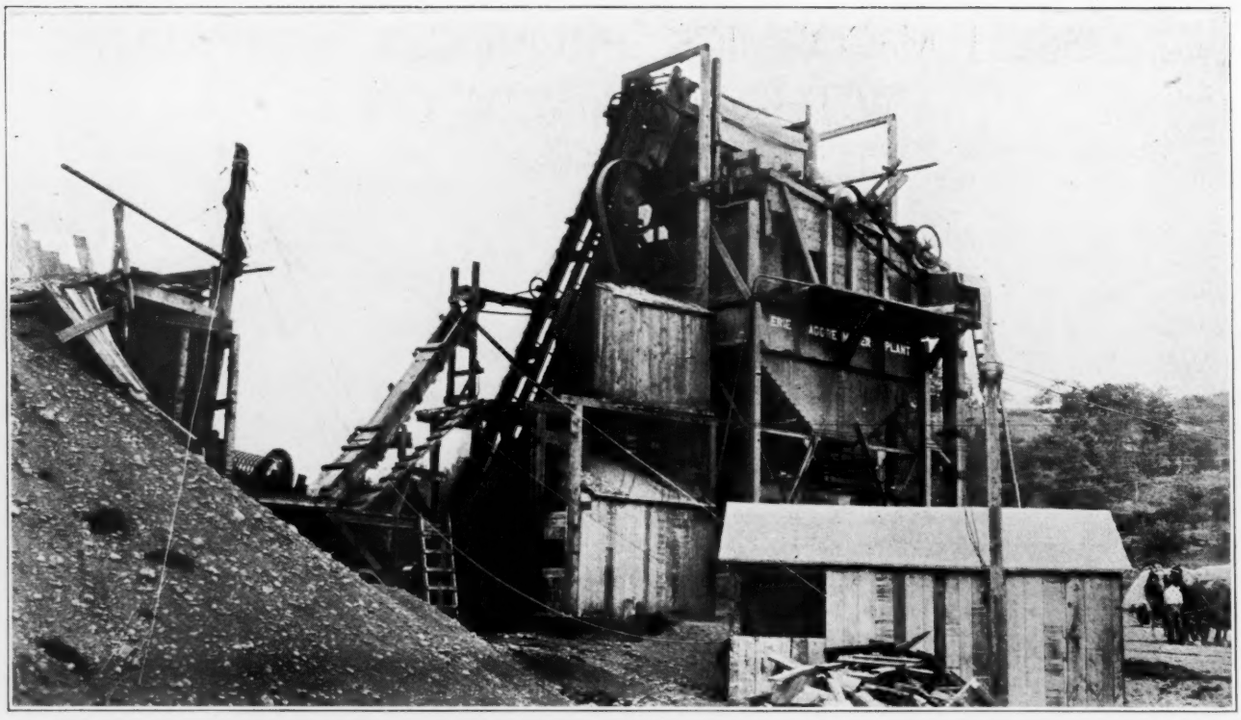
IN CERTAIN of the sparsely settled sections of New England, it is something of a problem to obtain aggregate for concrete highway construction. There is not enough other building and, as a matter of fact, not enough of this kind of road work to support general producers of this material except at a few centers.

Whenever a contract of this kind is let in these regions, it means a temporary plant to take care of the job. Of course the machinery may be moved from one job to another. This condition has been brought about by the use of concrete construction for first class trunk highways passing through more or less wild country. In these localities under ordinary conditions there is little or no call for sand, gravel or crushed stone for aggregate. This is typical of that part of Vermont, New Hampshire and Maine which is so popular for the spending of vacations.

Several of these plants have been noted this summer. One of them, near the town of Paris, Maine, was started last July by Mr. Joseph McCormick, who had obtained a contract for building about seven miles of cement state highway. This being a fair sized contract, the question of obtaining the requisite amount of sand and gravel for the concrete became a problem of importance. As no plant was obtaining this material in the vicinity, Mr. McCormick started to produce his own sand and gravel.

Drag Line Scraper at work in Gravel Bank

Approach of the Drag Line Scraper to Grizzly over Scalping Screen



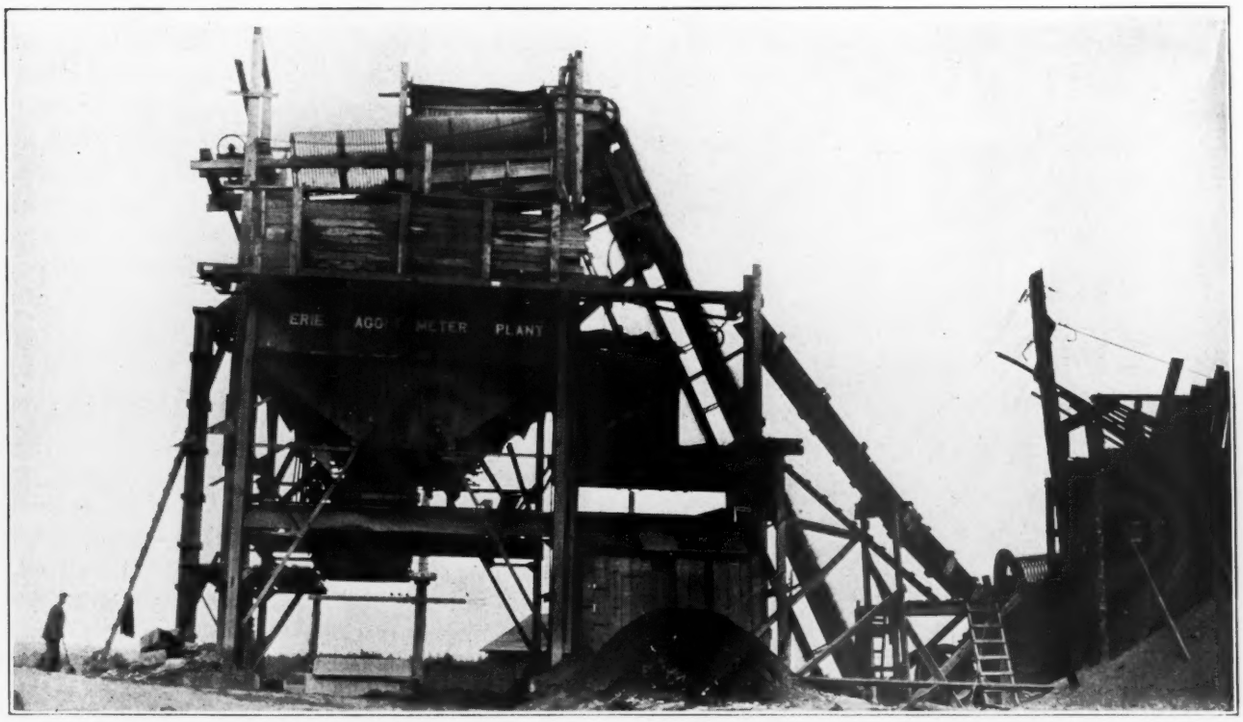
General view of Plant showing Drag Washer just below Sizing Screen

Fortunately there was a large available deposit of sand and gravel in a field bordering on the road under construction and a plant suitable for providing the kind of material required for this particular job was therefore installed. The plant was designed and the equipment furnished by the Good Roads Machinery Company and consists of a drag line scraper, operated by a Mead Morrison hoist driven by a 60 h.p. induction motor.

In operating the deposit the material is scraped directly into a hopper over the scalping screen. The result of this scraping is a deep groove or gully but by changing the angle of the drag line a fan shaped series will be developed to radiate from the hopper and the spaces between the ribs of the fan broken down and the material used.

A grizzly consisting of bars over the hopper retains the larger cobbles from the scalping screen.

View of Scalping Screen and Elevator



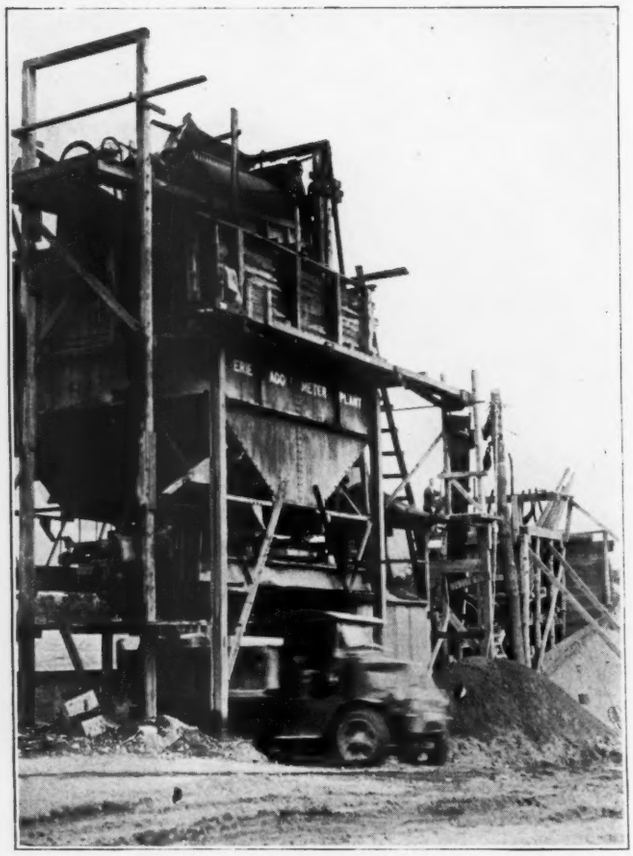
General View Showing Aggremeter

The tailings from the screen go to a jaw crusher and the crushed stone together with material which passes through the scalping screen taken by an elevator to the washing and sizing screen. Four sizes of sand and gravel are separated. The tailings from the screen are returned through a chute to the crusher.

The sand is washed in a Good Roads Machinery drag washer which is located to one side and below the screen, water for washing being obtained from a nearby stream. The different sizes are deposited in small bins above an Erie Aggremeter which turns out a uniform mixture ready to mix with the concrete.

This is a very satisfactory piece of equipment and greatly simplifies the work owing to the fact that the mixtures are always uniform and make inspection by the state road authorities very simple. The

Grizzly, Scalping Screen, Crusher and Elevator to Sizing Screen



Sizing Screen with Bins and Aggremeter Below

aggremeter also makes quick loading of the trucks possible.

The body of each truck is divided into four compartments and when the trucks are run under the aggremeter feeder, which also has four spouts, all compartments are loaded simultaneously. This takes no more than one and a half minutes to load 5 yards and as there are 19 Mack trucks, equipped with Wood hydraulic hoists, the matter of speedy loading is an important item.

More Potash Test Wells To Be Drilled

Contracts for the drilling of two additional potash test wells in southeastern New Mexico have been awarded by the United States Bureau of Mines, Department of Commerce, to the Sullivan Machinery Company. Under the terms of the contract, drilling operations are to start within a period of 30 days. Both new locations, which are recommended by the United States Geological Survey as giving favorable indications of the existence of potash beds, lie in Eddy County.

The site of the potash well number 2 is in the northeast corner of Sec. 14, T. 20 S., R. 29 E., approximately 37 miles from Artesia, New Mexico, and 25 miles from Carlsbad, New Mexico. The depth to the top of the salt beds at this location is estimated at about 500 feet. Drilling will be continued to a depth of 1,000 or 1,500 feet, as conditions may determine, this allowing penetration of most of the estimated thickness of the salt beds in this region. The site of potash well number 3 is in the SW. ¼ of Sec. 34, T. 22 S., R. 30 E., and is about 28 miles from Carlsbad. The depth for drilling is the same as for well number 2.

Both locations are on the western limit of the potash-bearing salt beds identified in this region, and have a minimum of overburden. For each test a continuous core will be taken from top to bottom and each hole must bottom with not less than a 2½-inch core.

The diamond-drilling outfit used in the drilling of potash well number 1, also located in Eddy County, will be moved immediately to the site of well number 2. The drilling of potash well number 1 was completed April 9, at a depth of 1,847 ft. 6 in., drilling operations having been in progress since February 21. At this location, the hole penetrated the salt beds at a depth of about 850 feet. Various favorable showings of potash-bearing salts were encountered in this well. To a depth of 150 ft., coring of the soft "red beds" overlying the salt formation, with equipment consisting of a standard bit and single-tube core-barrel, was attempted unsuccessfully. From 150 ft. to the bottom of the hole a specially designed bit and double-tube core-barrel were used and 1,600 ft. of core, amounting to 94 per cent, was recovered. The 6 per cent loss was due to attrition, and to occasional thin seams of sand or soft clay interbedded in the harder formation.

More Skilled Labor Coming in Now as Result of Immigration Law

Skilled labor is coming into the United States in greater proportions under the Immigration Restriction Law than under the old plan of non-restriction according to a study by the Federal Government.

From 1911 to 1914 and before the passage of the present law which became effective in 1921, skilled laborers constituted about 15 per cent of all immigrants. In 1925 and 1926 the proportion of skilled labor increased 19 per cent. Unskilled workers constituted 41 per cent of all immigrants during 1911-1914, but during 1925-1926 the proportion of unskilled workers declined 19 per cent.

Immigrants listed as having no occupation constitute a larger proportion under restriction than before it showing an increase of 15 per cent. This group, however, includes women, children and dependents.

RESEARCHES ON PLASTER OF PARIS

By M. L. Chassevent*

DURING the last few years, plaster of Paris has not been made the object of as numerous investigations as cement. Furthermore, the results obtained by different investigators have in regard to many points been contradictory.

An attempt has been made in the course of the present investigation to study in a detailed manner the different phenomena taking place in the setting of plaster of paris, and to deduce from the result of these researches some facts of technical value and capable of application for industrial purposes.

The study of the setting of plaster of paris.—It has been observed that when a few particles of plaster of paris are added to a drop of water placed under the microscope, the particles of plaster of paris dissolve, and that at the same time a formation of crystals takes place. The hydration of plaster of Paris is due to the phenomena of solution and crystallization. Accordingly the study of the composition of the solution makes it possible to follow the course of rehydration of the plaster.

M. Le Chatelier has explained the setting of plaster of paris by the formation in contact with the semi-hydrated calcium sulphate which forms the plaster of paris for casting purposes, of supersaturated solutions which allow the deposition of crystals of gypsum, the elongated form of which, and the interlacing are favorable to cohesion. The composition of the solution formed with plaster of paris has been studied by the measuring of the electrical resistance. By means of calorimetry it has been possible to verify the interpretations of the results obtained by the study of the solution.

Anhydrous plaster prepared below 300 Cent. (572 Fahr.) gives in contact with water a solution, the concentration of which increases rapidly until a level is reached at which it remains stationary. After some twenty minutes, crystallization commences, and the concentration of the solution diminishes until, finally, it arrives at the solubility of gypsum. (Curve I, Figure 1.)

Gypsum dehydrated at 145 Cent. (293 Fahr.) until it has suffered a loss of water equivalent to the formation of the semi-hydrate furnishes a solution, the maximum concentration of which is but little less than of that obtained with anhydrous plaster. But the maximum is no longer an intermediate phase, due to the fact that this plaster contains traces of gypsum which accelerates the crystallization. (Curve II, Figure 1.)

The calorimetric study of the hydration has shown that anhydrous calcium sulphate burnt below 300 Cent. (572 Fahr.) is instantly, in contact with water, transformed into the semi-hydrate which gives a saturated solution of this compound (landing of curve I). This unstable solution, supersaturated with gypsum remains for a long time without crystallizing. In this manner it has been possible to prepare saturated solutions of the semi-hydrate and to determine the solubility curve from 0 degrees to 97 degrees of this compound. This curve, represented in Figure 2, shows that the difference in solubility of gypsum and that of the semi-hydrate is so much the greater, the lower the temperature.

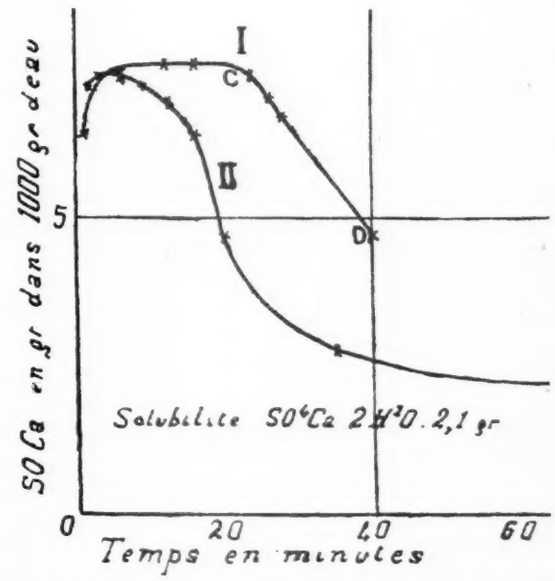


Figure 1. Variation in the composition of the solution during the hydration of the plaster. Solution at 30 degrees C.

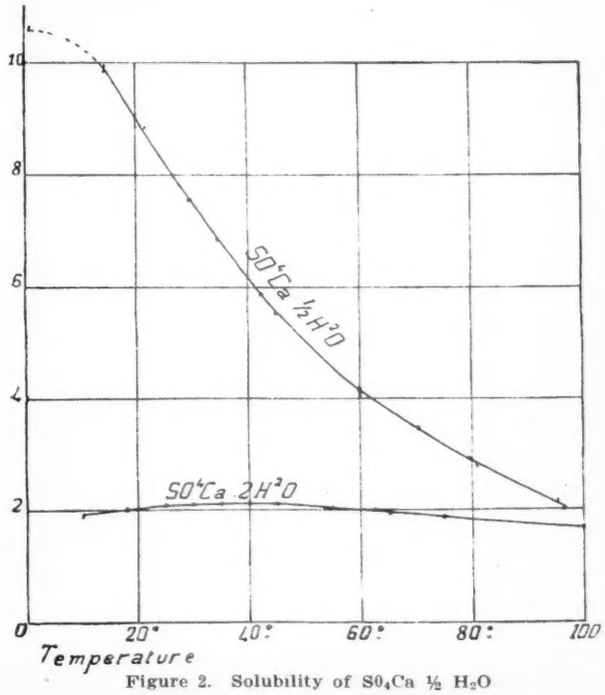


Figure 2. Solubility of SO_4Ca ½ H_2O

Abstracted with additions from "Bulletin de la société d'encouragement pour l'industrie nationale and annales de chemie, 1926-1927." For further scientific details see Thèse de Doctorat, June, 1926, and for further technical details, consult "Revue des materiaux de construction," number for October, 1926, and following issues.

*Translated by Universal Trade Press Syndicate, from Le Ciment, February, 1927.

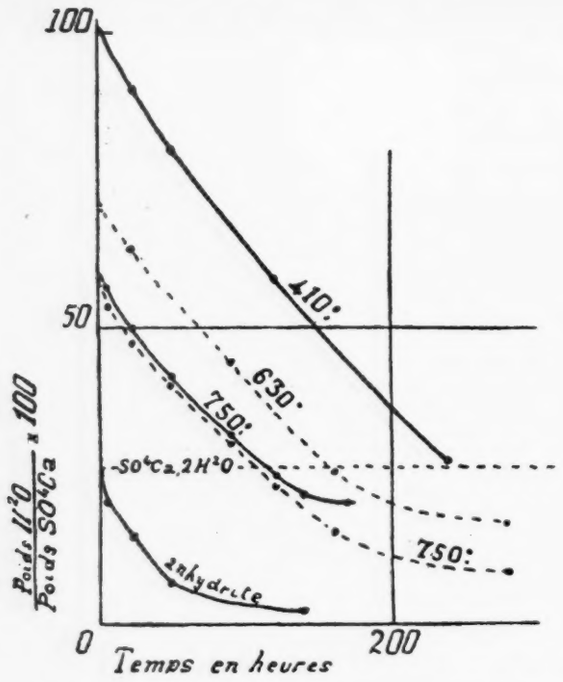


Figure 3. Loss of water at different temperatures of plasters burnt at different temperatures and hydrated.
Full lines = Plasters prepared from precipitated sulphates.
Dotted lines = commercial plaster reburnt.

The study of the composition of the solution and that of the liberation of heat has lead to the following results:

The setting of the anhydrous sulphate burnt below 300 Cent. (572 Fahr.) takes place in three phases:

1. An immediate and complete conversion of the anhydrous sulphate upon the contact with water into the semi-hydrate and solution of the latter to the saturation-point.

2. An inactive stage during which there is no change between liquid and solid.

3. Crystallization of gypsum and solution of undissolved semi-hydrate in the first phase until a complete transformation into gypsum has been effected.

The commencement of crystallization corresponds with the commencement of setting. It is made evident by a rise in temperature and by a drop in the concentration of the solution.

The setting of the semi-hydrate takes place under different conditions, depending upon a presence of gypsum in the same. Gypsum dehydrated rapidly at a temperature of 145 Cent. (293 Fahr.) in a closed crucible until there has been a loss of water equivalent to the formation of the semi-hydrate, still contains traces of gypsum which accelerate crystallization upon the addition of water. Then there occur solution of the semi-hydrate and crystallization of gypsum concurrently. On the contrary, the semi-hydrate obtained by rehydration by exposure to air of gypsum which has been dehydrated slowly and to a stage beyond that of semi-hydrate, gives a solution of semi-hydrate which remains a certain time without crystallizing.

Influence of the burning temperature upon the rapidity of hydration of plaster of paris—MM. Jolibois and Lefebvre* have observed that gypsum undergoes dehyration beyond the semi-hydrate stage only very slowly in an atmosphere of water under atmospheric pressure from 108 to 160 Cent. (226.4 to 320 Fahr.), while in dry air at all temperatures or in steam above 200 Cent. (392 Fahr.) anhydrous sulphate is formed. It has been proved that anhydrous plaster always undergoes hydration in the same manner provided it has been burnt at a temperature not exceeding 300 Cent. (572 Fahr.). For between 300 and 313 Cent. (572 to 595.5 Fahr.) the anhydrous sulphate undergoes a transformation into a new variety which is hydrated in contact with water, the more slowly the higher the temperature at which it has been burnt. The hydration of plaster burnt at a temperature below 300 Cent. (572 Fahr.) is complete in about one hour while there are required

57 hours for a plaster burnt at 350 Cent. (662 Fahr.)
96 hours for a plaster burnt at 400 to 600 Cent. (752 to 1112 Fahr.)
300 hours for a plaster burnt at 700 Cent. (1292 Fahr.)
Over 380 hours for a plaster burnt at 1000 Cent. (1832 Fahr.)

Accordingly the temperature of 300 Cent. (572 Fahr.) is to be considered as the limit, above which dead burning commences. All plaster burnt above 300 Cent. (572 Fahr.) gives supersaturated solutions which allow the plaster to set when under water. These plasters of paris when exposed to the air after addition of water, lose water by drainage the more readily the higher their burning temperature. This action together with evaporation results in that in the greater part of cases, plaster burnt above 600 Cent. (1112 Fahr.) are quite dry before their complete rehydration (Figure 3).

The dead burnt sulphate is chiefly found in the lower portions of material in the furnace which are found directly in contact with the flames. Material burnt between 300 and 600 Cent. (572 and 1112 Fahr.) commences to undergo hydration upon the addition of water. There is at the outset a rapid setting which makes the use of this plaster difficult; besides the portions roasted at above 600 Cent. (1112 Fahr.) remain in the most cases as inert material.

Study of the rapidity of crystallization in supersaturated solutions of calcium sulphate. The setting of plaster of paris is due as has previously been shown to two phenomena: solution of the plaster and crystallization of gypsum. These two phenomena have been studied separately. By treatment of plaster burnt at 200 Cent. (392 Fahr.) a saturated solution of semi-hydrate supersaturated with gypsum has been obtained. This solution has been separated from the solid before the inset of crystallization, and the variation of the

*C. R. Academie des Sciences, 1923, t. 170, p. 1327.

concentration has been studied in the function of time.

At 16 Cent. (60.8 Fahr.) the saturated solution of semi-hydrated calcium sulphate remained 25 to 28 minutes without crystallization whatever may have been the precautions taken to prevent the exterior germs. Thus it appears that this space of time may be considered as the maximum duration of conservation of the water mixed plaster at the surrounding temperature in the absence of agents retarding the setting. The commencement of crystallization of these saturated solutions of semi-hydrate takes place after 65 minutes at 60 Cent. (140 Fahr.) and after 85 minutes at 77 Cent. (160.6 Fahr.*).

The influence of gypsum upon the rapidity of crystallization.—

The particles of gypsum rock in insufficiently burnt plaster contain gypsum. This body accelerates very actively the crystallization of the supersaturated solutions formed in contact with plaster. Figure 4 represents the crystallization of a saturated solution of semi-hydrate, either alone (curve A) or in admixture with variable amounts of gypsum indicated on the face of each curve.

The influence of the temperature upon the rapidity of crystallization of saturated solutions of semi-hydrate is represented by Figure 5. Gypsum actively accelerates the crystallization at 16.5, 30, 40, and 50 Cent. Above 60 Cent. the supersaturated solutions allow the formation of crystals only very slowly, even in the presence of a considerable amount of gypsum.

The influence of Salts, Bases, and Acids upon the rapidity of hydration of plaster.—The influence of different compounds upon the rapidity of hydration of plaster has been studied calorimetrically. Anhydrous calcium sulphate burned at 200 Cent. (392 Fahr.) was the first compound to be studied. This compound is transformed into the semi-hydrate free from germs in contact with water giving an identical in different trials, while the semi-hydrate may contain a variable quantity of germs of gypsum. (Weight of the $CaSO_4$, 2.47 grms.; water 100 cm^3.)

The rise in temperature made it possible to follow, easily, the hydration. It demonstrates at the same time the existence of a reaction between the dissolved salt and the calcium sulphate. Potassium sulphate and potassium chloride act in the same way in the hydration of plaster. These compounds accelerate the crystallization and shorten the length of time that the supersaturated solution remains without crystallization taking place.

The calorimetic curves are represented in Figures 6 and 7. They show that in the case of solu-

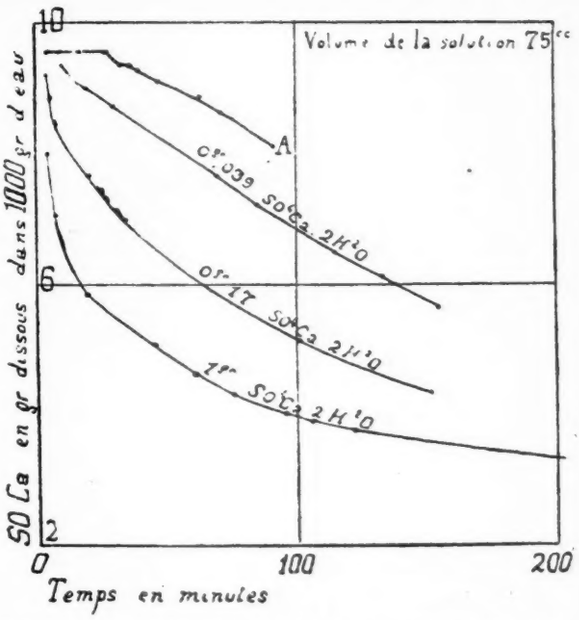


Figure 4. Crystallization at 16.5 C. of saturated solution of $SO_4Ca\frac{1}{2}H_2O$

tions of a concentration below 18.2 grams of KC1, and 24 grams of K_2SO_4 to the liter, gypsum, alone is formed, while in the case of solutions with 45 to 60 grams of potassium sluphate, and of 91 to 182 grams of potassium chloride, there is a reaction between the dissolved salt and the calcium sulphate. The study of the solution and of the crystals showed that the potassium chloride and the potassium sulphate were partially carried away in the crystals, this precipitation of dissolved salt accelerating the crystallization of the plaster.

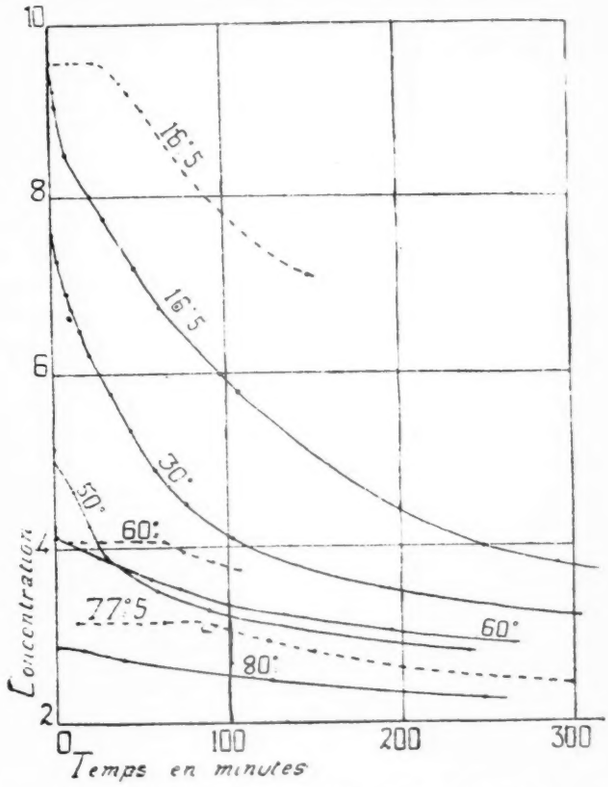


Figure 5. Rapidity of Crystallization of saturated solutions of semi-hydrate
Full lines = 75 cm^3 of solution plus 0.17 grams of $CASO_4 2H_2O$
Dotted lines = 75 cm^3 of solution alone.

*The studies of the rapidity of crystallization have been carried out in the presence of air saturated with water.
If plaster treated with water be maintained hot in the open air, the evaporation causes the formation of germs of gypsum and an acceleration of the drying of the plaster. The commencement of the setting and the rapidity of the hardening then pass in function of the temperature by a maximum variable with the surface and the conditions of evaporation.

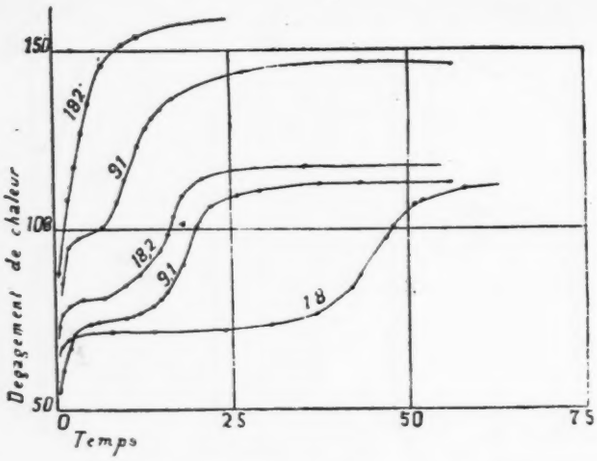


Figure 6. Influence of Potassium Chloride

Aluminum sulphate activates the crystallization of plaster, and remains wholly in solution in concentration below 160 grams of $(SO_4)_3Al_2$ per liter. The action of the aluminum sulphate is much more energetic on an impure plaster containing lime and calcium carbonate than on pure plaster. The formation of a precipitate by the action of the lime upon the aluminum sulphate accelerates the transformation of the plaster of paris into gypsum.

The action of alum, and that of sulphuric acid, are represented by figures 8 and 9. Rohland has explained the influence of salts upon the rapidity of the setting of plaster of paris by the variation of the solubility of the gypsum. But it has been proven that bodies such as potassium sulphate and potassium chloride which act in an opposite manner upon the solubility of gypsum and upon that of the semi-hydrate, have an identical action upon the rapidity of hydration of plaster. Accordingly the explanation of Rohland becomes invalid.

The conclusions here arrived at upon the influence of bodies in solution upon the rapidity of hydration of plaster of paris are the following:

1) Bodies which increase the concentration of the solution in SO_4 ions diminish the duration of the commencement of the setting of the plaster, and accelerates the crystallization. This increase of the concentration in SO_4 can be obtained either

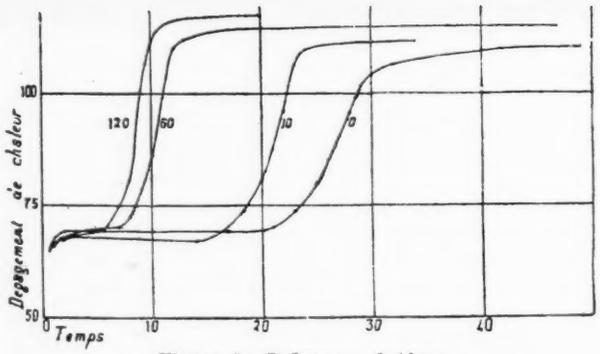


Figure 8. Influence of Alum

by the presence of soluble sulphates or by the double decomposition between the saline solution and the calcium sulphate.

2) Dilute acids which do not give precipitates with calcium sulphate accelerate the hydration.

3) The crystallization of gypsum can be accelerated and activated by an accessory crystallization such as an intermediary or definite combination of the dissolved salt with the semi-hydrate or the gypsum, (SO_4K_2 and KC1) or by a reaction between the dissolved salts and the impurities contained in the plaster (lime and aluminum sulphate).

The Testing of Plaster of Paris.—Chemical Analysis.—The material as it leaves the furnace after the burning, consists of a mixture of semi-hydrate, non-dehydrated gypsum, anhydrous sulphate burnt below 300 Cent. (572 Fahr.), and finally, anhydrous sulphate burnt at above 300 Cent. (572 Fahr.).

The chemical analysis which is based upon the differences of the rapidity of the hydration and the dehydration of these compounds, allows the determination of the quantity of each. However, this analysis furnishes only an insufficient information in regard to the properties of the mixture. The gypsum is determined by difference. It is, however, difficult to fix a gypsum content of one to two per cent, such an amount being capable of causing a considerable variation in the commencement and the rapidity of the setting, furthermore, gypsum acts in a more or less energetic manner according to its distribution in the mass and the size of the particles. Thus it may happen that two plasters of

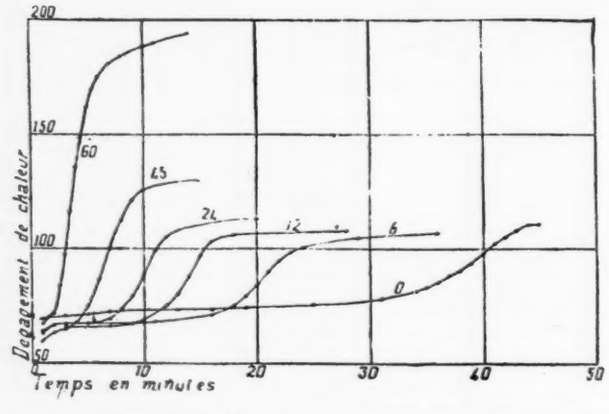


Figure 7. Influence of Potassium Sulphate

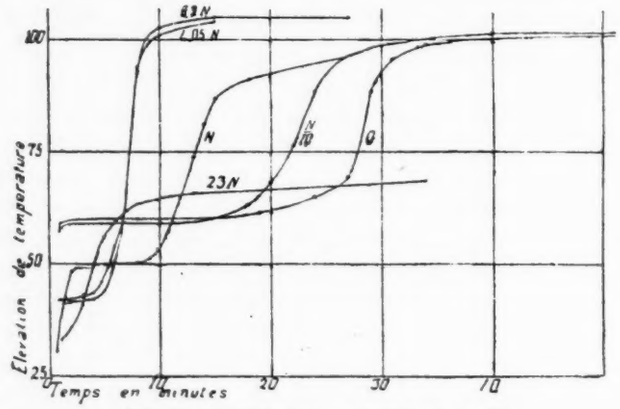


Figure 9. Influence of Sulphuric Acid

an identical chemical composition may have different properties.

The Calorimetric Method.—The calorimetric method which has been employed makes it possible to measure quickly the rapidity of hydration of a plaster, and accordingly its properties.

In figures 10 and 11 the results of the calorimetric examination of plasters prepared under differing conditions are shown. Weight of plaster corresponds to 2.47 grms. of $CaSO_4$, water 100 cm^3. The curve 1 shown in figure 10 has been obtained with a plaster obtained by means of precipitation and insufficiently burnt. This calorimetric curve does not show a landing stage. Crystallization (setting) commenced upon the addition of water and the amount of heat liberated showed that this plaster contained only 44 per cent of active material (semi-hydrate). Curve 2 was obtained with precipitation sulphate burnt in steam. It still contained gypsum which favored the setting.

By a continued increase in the length of the burning, plasters were obtained, the calorimetric curves of which were more and more flattened. (Setting increasingly slower.) Curve 4 was obtained with calcium sulphate completely dehydrated at 200 Cent. (392 Fahr.) in a current of air, and preserved in a stoppered bottle until used. This plaster commenced to undergo an immediate transformation into semi-hydrate in contact with water, first liberation of heat, and commenced to set in 18 minutes. This same plaster dehydrated at 200 Cent. (392 Fahr.), exposed to the air after burning underwent partial hydration, and from the time of the addition of water no longer contained any anhydrous sulphate, as indicated by curve 3. The calorimetric curves shown in figure 11 are for plaster prepared from a fairly pure gypsum rock. Curve A, plaster burnt at 145 Cent. (293 Fahr.) in an atmosphere of steam;—Curve C, plaster burnt at 200 Cent. (392 Fahr.) in a current of air;—Curve B, plaster burnt at 200 Cent. (392 Fahr.) and exposed to the air before treatment with water;—Curve D, coarse plaster of commerce—fast setting.

The form of the calorimetric curves and the heat liberations observed make it possible to determine rapidly the commencement of the setting, the rapidity of transformation into gypsum, and the composition of a given plaster. The rapidity of setting can be expressed by the quantity of plaster converted into gypsum after 5, 10, 20....., n minutes. Transformation of 1 gram of semi-hydrate disengages 25 calories.

The Vicat needle, on the contrary, furnishes only incomplete information in regard to the rapidity of the setting of a plaster. The commencement of the setting may indeed furnish indications in regard to the variation of the plasticity of the paste, even though the commencement of the setting may vary some with the amount of water added. But

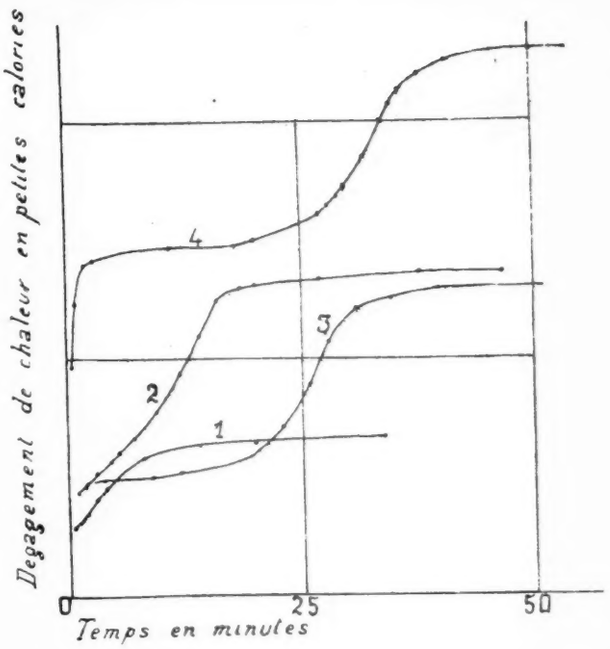


Figure 10. Calorimetric Study of Plaster prepared from precipitated sulphate.

the height at which the needle is maintained above the bottom of the mold does not allow the presentation of the setting in the function of time. This height, in fact, is variable with the amount of water taken, in case the amount of water taken is large, 70 to 80 parts to 100 parts of plaster, the Vicat needle does not show a completion of setting after several hours, while the hydration is accomplished in about one hour approximately. (In the case of plaster not containing any dead burnt material.) The observation of the liberation of heat, on the contrary, makes it easy to follow the course of the hydration of a plaster.

Testing the mechanical Resistance of Plaster.—The influence of the amount of water used upon the

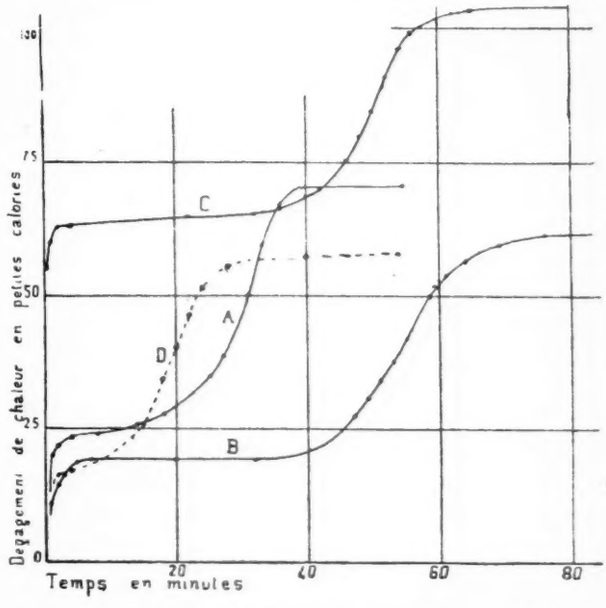


Figure 11. Calorimetric Study of Plasters prepared from Gypsum Rock

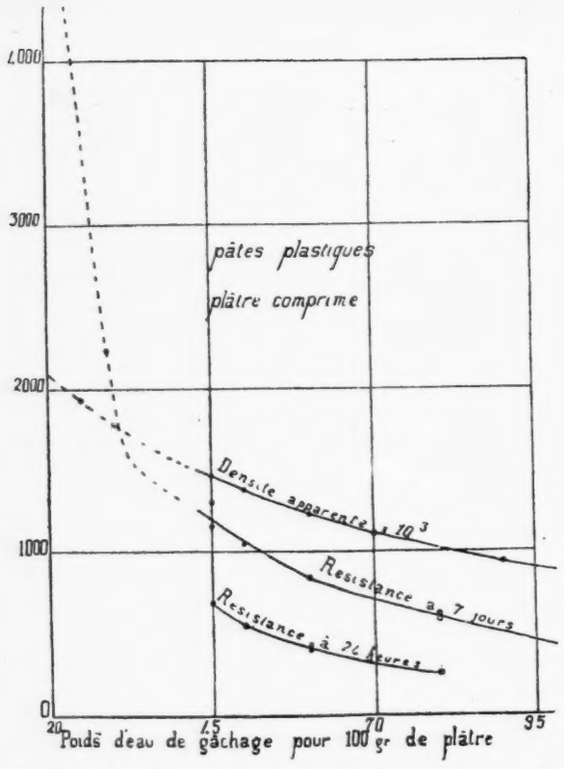


Figure 12. Variation of the apparent density and of the resistance of plaster to compression in function of quantity of added water

resistance to compression of a moulding plaster. The results are given in the table.

Weight of Water to 100 grams Plaster	Resistance to Compression of a cylinder diameter 0.03 mm., height 0.03 mm. After 24 Hours		After 7 Days in the Air		Apparent Density
	Total	In Kg. Cm²	Total	In Kg. Cm²	
45	690 kg.	98	{ 1.300 kg. { 1.150 kg.	{ 186 { 164	1.46
50	550 kg.	79	1.050 kg.	150	1.375
60	{ 400 kg. { 430 kg.	{ 57 { 61	840 kg.	120	1.23
70					1.115
80	{ 250 kg. { 260 kg.	{ 36 { 37	580 kg. 620 kg.	83 89	1.02
90					0.94
100			400 kg.	57	0.87

The increase of resistance in 1 to 7 days is due solely to the drying in the air, the hydration of the plaster being completed in about one hour approximately. The resistance of completely rehydrated plaster diminishes upon immersion in water. (125 kilo.: cm.²—56 after keeping for a week in water saturated with gypsum. The resistance of a plaster, accordingly, varies considerably, in accordance to the conditions of conservation, whether in the open air, or in stoppered bottles, the size of the containers, etc.

The resistance of a given plaster to compression may vary, as has just been shown, more than 50 per cent, depending upon whether the test tubes are dry, or whether they have been kept in water, it being possible to obtain all the intermediary resistances between these two extreme values, according as to the test tubes containing at the time of the trial more or less water. Furthermore, it is to be noted that plasters containing calcium sulphate burnt at above 300 Cent. (572 Fahr.) continue to show an increase after 24 hours if the test tubes have been kept moist or under water until the time of the test. Accordingly, it would be highly desirable, when information is desired in regard to the quality of a plaster, to state not only the resistance shown, but also at the same time the conditions under which the test was carried out for the determination of resistance. Otherwise, there is a great risk of large differences in the results of different workers, without it being possible to ascertain the causes of the discrepancies.

In all trials of a later date than those referred to the testing has been carried out in the following manner: The test tubes were immersed two hours after the mixing in a saturated solution of gypsum (water to which a small amount of plaster has been added) and so kept until the time of the test (24 hours and seven days). A part of the test tubes were then submitted to compression upon their being taken out of the solution, another part again, after being dried to constant weight in the drying oven at 50 to 55 Cent. (122-131 Fahr.) and being allowed to cool. The figures obtained thus indicate the extreme resistance values of a given plaster, that is to say, when all the pores of the plaster are filled with water, and when the plaster is completely dry.

The results obtained upon the crushing of the tubes upon their being taken out of the solution show a greater relative variation on account of their weaker resistance than those obtained with the dried tubes.

Figure 12 represents in function of the quantity of added water, the corresponding variations of the apparent density and of the resistance to compression of the plaster. (Resistance in kilograms for a cylinder of a section of 7.05 cm².

It is seen that the resistance of plaster to compression diminishes rapidly with the increase in the amount of added water. There results show that the qualities of a set plaster depend not only upon the quality of the plaster used, which often receives the entire blame, but also upon the conditions under which the addition of water and the use of the plaster take place.

Accordingly it is interesting to determine the causes of insufficient hardening. A defective hardening of plaster is due, either to the presence of dead burnt material which has not undergone rehydration at the time of the total drying of the mass, or to poor manufacture.

The analysis makes it easy to prove the presence of dead burnt and inert material, and by following the increase in weight in function of time of the powder covered with water.

The poor execution of a work in plaster is generally due to the use of an excess of water, or to the addition of water to plaster after it has commenced

(Continued on page 80)

ACOUSTICAL ANALYSIS METHODS

By Wallace Waterfall, Acoustical Engineer, Celotex Company*

THE writer has had a number of requests for a rather complete discussion of the methods of analysis used in an engineering department devoted entirely to this kind of work, and, although the peculiarities of the individual jobs cannot be minutely discussed, it seems that a more detailed exposition of the major factors might not be amiss. The same general analytical methods can be applied to auditoriums of all sizes and classes but are not intended to be used for the calculation of acoustical treatment in offices, factories and elsewhere where quiet is desired.

Behavior of Sound

When a sound is made in an enclosure, sound waves pass out in all directions traveling at the rate of approximately 1100 feet per second. At this speed they very quickly strike the interior surfaces of the room and are either reflected or absorbed, depending on the character of the surface. Most ordinary building materials are excellent reflectors and so the waves are reflected back and forth and around the room in all directions many times until enough of the sound is absorbed until it is no longer audible. This continued reflection produces a trail of sound or a sort of ringing sound which may last several seconds after the sound is made. This continuation of the sound after the actual source has stopped is termed reverberation.

Now the hearing conditions of auditoriums are dependent upon two factors: the proper disposition of sound to all parts of the room, and the proper absorption of sound after being distributed. Proper distribution includes an even spread of sound to all parts of the room and depends largely upon the size and shape of the room and other items which will be considered later. When the sound has reached all parts of the room it must then be absorbed to allow for the next sound of speech or music following it. In a room where the reverberation following each sound continues too long, the syllables of speech or tones of music will run together and are indistinct and difficult to understand. Excess reverberation is the cause of the majority of acoustical difficulties and it is this problem that requires mathematical solution when the engineer prepares his acoustical analysis.

He is given a room of definite shape and, although he can make suggestions he is not expected to make radical alterations in the proportions. He is expected to make that room as good as possible acoustically and he knows that, if it is of the usual shape, he can be sure of pretty good hearing conditions if he makes the proper adjustment of reverberation.

Method of Calculation

It is not necessary here to derive the formula used in calculating reverberation. This is generally known as the Sabine formula, taking its name from Professor Wallace C. Sabine of Harvard, who developed it and did much of the pioneer work in architectural acoustics. It can be briefly stated and explained as is done with many other formulae in engineering textbooks. It is usually written:

$$t = \frac{0.05 \times \text{Volume}}{a}$$

"t" is the period of reverberation in the room or length of time which a sound of standard intensity will last, as explained, before it becomes inaudible. "t" is expressed in seconds. The "Volume" is the entire volume of the interior in cubic feet. "a" is the number of units of absorption present in the room. This unit has not yet been explained.

It has been said that when a sound wave strikes the interior surfaces of a room it is usually mostly reflected, but a part of the sound is absorbed, the amount being dependent on the porosity and other characteristics of the surface. In order to have some basis for calculation we must have a unit of absorption and this has been chosen as one square foot of surface which absorbs all the sound that strikes it and reflects none. A surface that is totally absorbent is said to have a coefficient of absorption of 1.00. One which absorbs only one-fourth of the sound that strikes it has a coefficient of .25. One square foot of a surface with a coefficient of 1.00 furnishes one unit of absorption. With a surface having a coefficient of .25, four square feet will be required to give a unit of absorption. Thus, to find the number of units of absorption present in a room, we must find the areas in square feet of each material forming a part of the interior surfaces, multiply these areas by the coefficient of absorption of each particular material and add the total. Coefficients of the various materials and objects ordinarily encountered are outlined in Table I.

The table contains absorption values for several individual objects, first among which is the absorption of the audience, per person, listed at 4.7 units. This shows that the audience is quite a factor in determining hearing conditions. It is a common experience that an empty auditorium often sounds much different than one which is filled with people and the difference is caused entirely by absorption of the audience. The seats

*Abstract of an article appearing in the Bulletin of the Minnesota Federation of Architectural and Engineering Societies, March, 1927.

are also given an absorption value per seat. In figuring the total absorption of a room empty, the seats are included and then when the absorption of the audience is added the value assigned to the seat is deducted from the absorption of the individual. For example, if the seats are taken at 12, then when the effect of the audience is calculated, it is assumed that the absorption of the seat is removed because it is covered by the person seated and the audience added at 4.5 units (4.7-0.2) each.

We now have the formula and the method used in determining periods of reverberation. The calculated period of reverberation will do us little good, however, unless we know what periods of reverberation have been found to produce the most satisfactory hearing conditions.

Experiments and general facts have shown that the periods of reverberation which produce the best average conditions vary with the volume of the room as shown in Table II. To correct the hearing conditions of a room of certain volume, we try to have the period of reverberation reach the figure given in the table with an average audience included. If there is no specific information to the contrary, the average audience is usually taken at about two-thirds maximum audience.

TABLE I—COEFFICIENT OF ABSORPTION

Plaster	.025 to .035
Glass	.027
Concrete	.015
Wood varnished	.03
Linoleum	.03
Cork Tile	.03
Curtains, in folds	.25 to .75
Carpets	.15 to .25
Individual Objects	
Adult Audience, per person	4.7 units
Upholstered seats, per seat	.75 to 2.5
Wood Seats and Church pews, per seat	.20

TABLE II—OPTIMUS PERIOD OF REVERBERATION

Below 7,000 Cu. Ft.	1.0 seconds
7,000 to 20,000	1.1 seconds
20,000 to 45,000	1.2 seconds
45,000 to 85,000	1.3 seconds
85,000 to 145,000	1.4 seconds
145,000 to 225,000	1.5 seconds
225,000 to 330,000	1.6 seconds
330,000 to 465,000	1.7 seconds
465,000 to 630,000	1.8 seconds
630,000 to 835,000	1.9 seconds
835,000 to 1,100,000	2.0 seconds

(Continued from page 68)

1. The clinker burnt below 1340 Cent. (2444 Fahr.) must show poor setting properties, poor storing durability, and defective hardening properties.

2. The densities of the cements must improve with the progress of the reactions during the burning.

3. It is not possible to say with absolute certainty that the amount of the fusion must increase, it may be true that in the opinion of Kühl material continually passes into solution, but at the same time as the result of the reactions taking place in the solution new compounds crystallize out. In any case, however, the progress of the reaction must lead to a powerful condensation of the structure.

4. Rapid cooling is conducive to an improvement of the solidity, inasmuch as fixed inequalities make for an increase in the value of portland cement clinker.

Biehl* studied the influence of burning temperature, duration of burning, and rapidity of cooling on the hardening properties and crystal formation in clinker which had been obtained at times from the shaft kiln, at other times from the rotary kiln. He came to the conclusion that a longer period of burning, and increased temperature, as well as fusion, improve the quality of portland cement. The latter is especially to be noted, as being in contradiction to the opinion of most other investigators.

*Biehl, Zur Petrographie des Portlandzementklinkers. Zementprot. 1925, S. 185.

(Continued from page 78)

to set, or to the employment of plaster which has deteriorated through exposure to the moisture of the air. An excess of water causes after the drying an increase in the volume of the void spaces and consequently a decrease in resistance. The increase of the porosity, on the other hand, has a great influence upon the resistance of the plaster to inclemencies of weather. (Rain and frost)—

The determination of the apparent density d′ and the specific density d of a hardened plaster gives information in regard to the conditions under which the plaster has been employed ($d = 2.32$ for a plaster which has set and does not contain dead burnt or foreign material). The ratio $\frac{d}{d-d'}$ gives the proportion of voids in the piece of hardened plaster studied. A proportion exceeding 52 per 100 corresponds to a mixing made with more than 70 grams of water to 100 grams of plaster.

Accordingly it seems evident that the determination of dead burnt material and the porosity of the plaster will furnish useful information as to whether it is the plaster or the manner of the execution of the work which is at fault in a given case.

Polishing Portland Cement Concrete

The nature of the aggregate is important, one which is fine in grain and hard is better than a coarse grained soft material. Marble and granite are good for this purpose. A surface consisting entirely of aggregate would be best for this purpose and therefore, the aim should be to get as much aggregate on the surface as possible. For the floor aggregate is often sprinkled on top and rolled in. Carborundum is now used extensively for polishing floors. Blocks of carborundum are made in a variety of shapes and sizes and grits for both machine and handwork. (J. Singleton-Green Concrete & Const., Engineering, London, March, 1927, 198-204.)

CALCINED MAGNESITE
ITS PROPERTIES AND EXAMINATION

STUDY of the chemical changes occurring in calcined magnesite was based on the manner in which calcined native magnesite, artificial magnesite and lime react with air, increase in weight resulting. Tests were made with: 1) Austrian Magnesite from Kraubath, 2) Artificial Magnesite (Magnesium Oxide) obtained by calcining precipitated magnesium carbonate, and 3) pure lime (Calcium oxide).

Each one, before being used, was freshly ignited. After cooling in dessicator, portions of three grammes were weighed out and placed in small Erlenmeyer flasks and exposed to the action of the atmosphere. The following table shows the percentage of water, etc., absorbed after exposure for periods of 2, 4, 9 and 12 days, the loss of water in dessicator with calcium chloride in case of the product after exposure to the maximum time given, also total loss of moisture at 105-110 C which includes the preliminary loss in the dessicator over calcium chloride.

	Increase in weight-days.				Loss in Dessicator	Total Loss
	2	4	9	12	over Ca Cl_2	at 105-110 C
1) Austrian Magnesite	0.93	1.10	1.53	1.63%	0.53%	0.77%
2) Artificial Magnesite	0.97	2.57	4.17	4.43	0.83	1.67
3) Lime	2.53	5.53	15.27	20.87	*	**

*Increase 1.07 per cent.

**Owing to the strong absorption of carbon dioxide in the drying oven the results were useless.

As a result of its finer state of division, the artificial magnesite showed already in 9 days an increase in the absorbed moisture three times greater than that of the natural magnesite, while affinity of lime for moisture is four times as great as that of magnesium oxide. The far stronger affinity of calcium oxide for water, over that of magnesium oxide was further shown in the drying over calcium chloride in the dessicator when an increase of weight of 1.07 per cent was noted, as the water given off from the magnesite samples was absorbed more rapidly by the lime than by the calcium chloride. (The samples were dried simultaneously in the same dessicator.) The water lost at 105-110 C. is hygroscopic moisture, in other words, non-chemically combined water.

A second series of experiments were made with freshly calcined Euböa magnesite and with artificial magnesite prepared from magnesium carbonate. Four grammes of each being subjected to moisture absorption.

Under these conditions also, it is shown that pure magnesium oxide absorbs an amount of water about three times greater than that absorbed by calcined native magnesite, at the same time we arrive at a fact which enables us to differentiate between on the one hand—chemically combined water—on the other hand mechanically absorbed and retained water (hygroscopic moisture).

This series of moisture absorption tests were conducted with the exclusion of carbon dioxide, so that the increase of weight can be due only to magnesium hydroxide, which, according to Gmelin-Kraut* does not decompose until 350 C. The difference between absorbed moisture and moisture lost in the drying oven at 105-110 C. is chemically combined water. Thus the Greek calcined native magnesite shows 4.10 per cent hygroscopic moisture. 16.70 — 4.10 = 12.60, which represents the per cent of chemically combined water. For artificial magnesite the corresponding figures were 8.72 per cent of hygroscopic moisture and 35.33 per cent of chemically combined water.

Completely hydrated magnesium oxide would give 144.68 per cent of magnesium hydroxide. The two moisture absorption tests thus show that a calcined magnesite will absorb a considerable amount of moisture before all the magnesium oxide is converted into magnesium hydroxide. If pure magnesium dried to a constant weight be exposed to the carbon dioxide—free atmosphere of the moisture chamber—it takes up 2.84 per cent of moisture in 16 days, of which 2.64 per cent is again, in turn, lost upon drying over phosphorus pentoxide in course of three days.

	Increase in weight—days				Loss—1st in vacuum water bath temperature	Loss—ordinary drying oven
	2	5	14	27		
Euböa magnesite	2.74	4.88	10.26	16.70%	3.98%	4.10%
Artificial magnesite	7.25	14.30	30.72	44.05%	8.72	8.72%

Editor's Note—Abstracted from "Ueber Gewinnung Eigenschaften und Untersuchung des gebrannten Magnesits" von Dr. Alfred Stettbacher, Zürich. Chemiker-Zeitung, No. 96, Oct. 13, 1926.

*Anorg. Chemie, II Bd., 2, 390.

In order to return to the first series of experiments in which exposure was to the atmospheric air, further trials were made with Euböa magnesite and with artificial magnesite, both being freshly ignited and fine grammes of each taken. The maximum length of exposure being 34 days. The results are shown here:

Net increase after—	Euböa magnesite	Artificial magnesite
2 days	3.45%	5.77%
9 days	7.10	9.64
22 days	9.69	17.51
34 days	12.08	26.97
Water lost at 105 C.	4.07	9.04
Carbon dioxide	4.65	10.70
Combined hydroxide water	3.36	7.23

The hydroxide water was taken as the difference between total absorbed water and the hygroscopic water plus the carbon dioxide. The determination can be made with a single sample as follows: The sample is dried to constant weight in the drying oven for three to four hours to obtain the content of hygroscopic water, then the determination of the carbon dioxide is carried out in the usual manner with hydrochloric acid.

Composition of Magnesite Calcined in Switzerland.

	a) Greek magnesite	b) Silesian magnesite
Loss on calcining	11.45%	6.75%
Carbon dioxide	4.16	2.98
Hygroscopic moisture	2.30	1.97
Hydroxide water— chemically combined	4.99	1.80

Composition of Silesian White Magnesite.

Total magnesium oxide	85.71	
Matter insoluble in hydrochloric acid, SiO_2, etc	6.74	
Carbon dioxide	2.98	
Hydroxide water	1.80	6.75
Hygroscopic moisture	1.97	
Calcium oxide	0.80	

Iron, alumina and SO_3 were not determined on account of the amount present being insignificant.

Magnesia Cement

On the composition and properties of the magnesia cement discovered by Sorel in 1867 there are to be found even in more recent literature some incorrect and contradictory statements. Accordingly an examination of its properties was made and its composition determined.

A cement to serve as material for this investigation was made as follows: the best freshly calcined Euböa magnesite was taken and made into a paste with magnesium chloride solution of s. gr. 1.24, the two being intimately and uniformly mixed in such proportion so as to form a paste of such a consistency that it could be poured into small narrow test tubes. After two days the product was very hard and dry and had cracked the walls of the tubes. It was powdered with difficulty and the powder preserved in well stoppered bottles. This could be considered as a representative sample of this cement. At 1050 C. it gave an ignition loss of 40.81 per cent and a fixed residue of 59.19 per cent. Determinations gave: magnesium oxide 57.32, carbon dioxide 0.24, chlorine 9.45 (corresponding to 12.69 of magnesium chloride or calcined, 5.34 of magnesium oxide), 1.87 of SiO_2, Fe_2O_3, Al_2O_3, CaO, etc. A loss of water was found to occur upon drying in a water-bath heated vacuum drying over for six hours, amounting to 8.78 per cent.

As in igniting magnesia cement the chlorine is quantitatively given off as hydrogen chloride, the total amount of water contained in the cement becomes evident from:

$$40.81 - (9.45 + 0.24) = 31.12 \quad (1)$$

The amount of caustic magnesia (i. e., that not combined with chlorine or with CO_2) is found according to:

$$57.32 - 5.34 = 51.98$$

As the result of further chemical computations the following composition is arrived at:

	Assuming as hygroscopic water: a) 8.78%	b) 12.14%
Magnesium hydroxide	71.41	60.53%
Magnesium oxide	2.63	10.15
Magnesium chloride	12.69	12.69
Ca CO_3 (from CO_2 0.24)	0.55	0.55
Moisture	8.78	12.14
	96.06	96.06

Similarly to crystallized magnesium chloride, magnesia cement retains water very tenaciously and looses hydrogen chloride continually but very slowly. The loss of hydrogen chloride commences already in the vacuum drying oven, but is more rapid at 110 C. It may be assumed that two-thirds of the water in the cement is chemically combined and that but very little free magnesium oxide is present. Magnesia cement absorbs dioxide from the air slowly, also water portions of the surface being converted into magnesium hydroxide.

Manufacture of Fused Cement

The materials, fused in the rotary kiln, are immediately run into a chamber in which an intimate mixing takes place, with the addition of a flux if necessary, the molten material being then subjected to a reduction process. The nozzle serving to conduct the heating medium is arranged so that the hottest part of the flames can reach the outlet of the kiln. The process can also be carried out on the counter-current principle. (G. Polysius, German Patent, 434, 187.)

1) Stettbacher, Sweiz. Chem.-Ztg. 1919, page 198, and 1921, page 113.

MAINTAINING LARGE STORAGE PILES WITH PORTABLE CONVEYORS

MAINTAINING a storage pile of 75,000 tons of sand built with one Barber-Greene portable conveyor, 18 inch x 70 feet, is the record made by Graham Brothers, Inc., at their Long Beach, California, plant. They have taken this machine off its wheeled truck and hung it from a 300-foot cable suspended between two towers.

The bunkers at this plant have a capacity of 10,000 tons, the largest bunk range unit on the Pacific Coast. A very complete system of conveyors operates in connection with the bunkers. The belt of the conveyor is 20 inch x 500 feet centers and a tripper discharges into any of the bunkers. Along the side of the bin runs a return belt which takes

Conveyor suspended between Towers—Long Beach plant

General view of Bins and Storage Piles—Long Beach Plant

Loading Bunkers from Barges—San Pedro Plant

the overflow from any of the bunkers and brings it back to the forward end of the plant where it is either recrushed to a smaller size, stockpiled by the Barber-Greene conveyor swung on the cableway, or loaded back into the bunkers.

At another plant of the same company located in the west basin of the San Pedro-Wilmington Harbor District, a portable Barber-Greene loader with a belt conveyor 18 inches wide on 60 foot center capable of loading bunkers or stock piling at a height of 20 feet is in operation, also a belt conveyor 20 inches wide on 70 foot centers is used for loading bunkers or stockpiling from barges. The conveyor leads up from the wharf to the bunkers and handles the material that is brought over from the Catalina Island rock plant. A clamshell is used to load the small hopper which discharges a steady stream on to the belt conveyor. A special suction machine is in use for cleaning the dust from the rock and gravel as it passes off the belt at the head pulley. A portable conveyor is used at the other side of the plant to convey sand into a special weighing bunker. The sand from this bunker is measured out in batches by weight.

View of Conveyor to Bunkers and Stock Piles—San Pedro Plant

General View of Conveyors—Lometa Plant

Graham Brothers also operate a pit in the Palos Verdes hills from which their Harbor City Sand is obtained. The first conveyor 18 inches wide on 200 foot centers, brings the sand from the pit to the washer. Here the plaster sand is dropped into the bins below the washer. A second belt 200 foot centers stretching off to the right takes the cement sand over to the hillside for storage, delivering to a Barber-Greene conveyor with a 100 foot belt capable of stockpiling sand over an area of half an acre and making possible a storage capacity of 15,000 tons. The permanent conveyors were built by Graham Brothers, Barber-Greene rolls being used throughout.

Farm Land Values Nearing Stability Bureau of Agriculture Claims

The value of farm real estate in the United States is showing an apparently steady approach toward stability, according to a report on the farm real estate situation for 1926 which has just been issued by the Bureau of Agriculture, division of land economics. There has been considerable regional variation, however, both in the amount of change since the peak farm real estate prices of 1920 and in the rate at which the change is still taking place.

The bureau's findings are from direct correspondence with farmers, appraisers, farm real estate dealers, land bankers and others in close contact with conditions in the farm lands market. The sampling method has been the only one so far available to the government statisticians.

The bureau's statement bears out directly the situation found by the last annual survey of the farm land situation made by the National Association of Real Estate Boards, which reported prices, though having a tendency to advance, fairly stable, at a level below that of 1920, but higher than that of 1914.

A steadily lessening rate of decline is shown by the bureau's information. Index for value of all farm lands with improvements stood on March 1, 1926, at a point slightly greater than 70 per cent of the high point reached in 1920.

Farm values have actually increased in a number of regions. In current dollars the March 1, 1926, value of American farm lands was indicated to be slightly above the value total recorded for the same period of 1917, or about 25 per cent above the 1912-13-14 average; but in terms of pre-war dollars this total was approximately 20 per cent below the base period.

Factors which are contributing to the upward trend in farm values are given by the bureau as primarily:

(a) Steady upward trend of available net farm income and prices of farm products.

(b) Reductions in mortgage rates in a number of areas, easing credit situation, improvement in country banking conditions and increasing general supply of funds seeking investment.

(c) Market absorption of foreclosures and other forced liquidations of the depression period.

In a number of areas this factor has probably already expended most of its influence, the bureau states. "This rise in farm taxes has been seriously out of proportion to the movement in the prices of farm products," the bureau's report states. Since taxes form one of the principal costs in farm ownership, the proportion of income required for payment of taxes continues to be a factor."

Glazed Cement Ware

Easily fused fluxes such as fluorides are applied to the surfaces of cement vessels, which are then heated gently just to the fusion point of the flux. A glaze is thus formed which is firmly knit to cement undersurface. Martin Harnisch (German Patent 439, 586).

SOME NORTHWEST FELDSPATHIC MINERALS

By Hewitt Wilson
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Part II.

In Part I of this article, which appeared in the last issue, the author stated the sources of the present demand for feldspar and the deposits which meet this need. The one first noted is at Deer Harbor, Orcas Island, San Juan County, Washington, and description, composition, sampling and preparation, physical test and cost of mining this deposit are given.—Editor.

Whiteware Tests

The Deer Harbor feldspar, calcined and ground in the University of Washington ceramic laboratory, has been the main source of feldspar for the pottery and glaze tests for the past two years. In this time over 100 dozen pieces of whiteware have been made by an experienced potter. This includes ware of the semivitrified, vitrified, and bone china types. The results from this large-scale test indicate without doubt that whiteware of the cheaper grades can be made from this feldspar and local Northwest kaolin. It is believed that the better class of wares can also be made on a commercial scale because they have been produced on a laboratory scale and fired in small kilns with quick heating and cooling under wide variations in heat treatment. The ware includes cups, saucers, cream pitchers, 7-inch nappies made by outside jiggering, 8-inch fruit dishes and an assortment of vases 8 inches high.

Avon, Idaho, Feldspar

Location and Geological Description. Sterrett gives the following description: "The deposits lie in a northbound belt about two miles wide and several miles long. The mines and prospects examined are in T. 41 N., R. 2 W., from three to six miles north of Avon. They lie at elevations of 3,400 to 4,700 feet above sea level, along the top and to the west of a high mountain ridge extending south from the Thatuna Hills.

"The mica deposits occur in an area of highly schistose metamorphic rocks of pre-Cambrian age. Muscovite and biotite schists and gneiss in which quartz is generally a prominent constituent, are the principal rock types of the region. Locally certain bands of the gneiss have an abundant development of black tourmaline crystals, especially near large pegmatite bodies. The gneisses and schists of the region strike roughly north and south, and the dips range from 50 degrees W. to vertical. Masses of pegmatite cut the gneiss and schist and are in many places entirely conformable with the schistosity and in others only in part or not at all. Some of the pegmatite bodies outcrop continuously for distances of several hundred yards, with few variations in thickness or direction. Others have smaller outcrops. A bulging or swelling of the pegmatite bodies into chimney-like deposits also occurs and gneisses and schists apparently contain more pegmatite in the valley to the west of the high mountain ridge than in the ridge itself."

Feldspar was found in the Last Chance, Luella and Muscovite mines. At the Last Chance mine several large dumps show considerable quantities of clean feldspar and others contain 50 per cent quartz. This has been thrown out by the mica miners. The Muscovite mine at the top of the hill shows a vertical 20-foot dike of semikaolinized feldspar. The other dikes encountered on the adjoining properties were small and irregular, so that mining would be difficult. Transportation would be a problem. A poor wagon road runs up a steep grade to the mines. Three years ago a logging railroad operated within a mile of the property. The nearest permanent railroad is at Avon, about six miles from the feldspar mine.

Physical and Chemical Properties

Chemical Analysis

SiO_2	66.80
Al_2O_3	19.65
Fe_2O_3	0.85
Na_2O	7.20
K_2O	3.00
CaO	2.01
	99.51

The above analysis indicates that this feldspar is one of the high soda-lime types. The material fuses at cones 6 to 7 with fast heating. Crushed fragments of the feldspar showed an index of refraction of 1.540. It is classified as an "intermediate" feldspar, probably largely composed of oligoclase. Some microcline was present in small quantities. Sericite, tourmaline and alteration to kaolin were also found. Whiteware tests in which this feldspar was substituted for commercial materials gave good results as regarded color and fusibility. However, extensive work was not done on this feldspar because of its comparative inaccessibility.

Feldspar from Cusick, Washington

The deposit lies between nine and ten miles east

of Cusick in south central Pend Oreille County, on the east side of Clarke Fork River, near the head waters of Ruby Creek and at an elevation between 3,000 and 4,000 feet above the railroad. The deposit is at least eight miles from a wagon road, although it was reported in 1924 that a logging road would operate very close to the deposit.

Character of the Feldspar

The samples that were sent to the laboratory indicated good feldspar, the size of the deposit was disappointing. A lense-shaped mass of feldspar was found in the side of a cliff of granodiorite. The outcrop of feldspar was about 30 feet long and only one to three feet thick and was heavily intergrown with coarse quartz. The deposit is of very little importance and the cost of transportation would be excessive. An analysis showed the following composition:

Chemical Analysis of Cusick Feldspar

66.58	SiO_2
19.64	Al_2O_3
0.78	Fe_2O_3
0.80	CaO
1.84	MgO
4.29	Na_2O
6.10	K_2O
0.24	Ignition
100.27	

The cone deformation test showed that softening took place at cones 6 to 7.

Miscellaneous Feldspar Deposits

Oregon Feldspar Prospects. Samples have been sent to this laboratory from near Gold Hill and Ashland in Jackson County, southern Oregon. A small amount of prospecting indicates that the bodies are small and scattered.

Microline Feldspar from Ashland, Oregon. "The sample is light pink in color and has a well developed basal cleavage. A basal thin section shows the characteristic grating-structure due to the polysynthetic twinning according to the albite and pericline laws. There are a few inclusions of quartz and some graphic intergrowth. The alteration is greatest near the quartz and also scattered in lines which are roughly parallel to the 100 face. Kaolin is the chief alteration mineral, although in the lines of alteration there are some fine, slightly colored grains, having a high index, which may be epidote. The refractive indices as determined by oils seem to agree with those for true microcline, $KAlSi_3O_8$."

Graphic Granite with Anorthoclase Gold Hill, Oregon

Prof. Goodspeed gave the following description: "The sample was a light colored, almost white feldspar in a rather fine micrographic intergrowth with colorless quartz. It probably contains 60 per cent feldspar and 40 per cent quartz. Under the microscope in thin section the feldspar is seen to be microcline and from the indices of refraction it seems to be nearer soda-microcline or anorthoclase than true microcline. A few grains of plagioclase (albite) are associated with the quartz. The alteration (chiefly kaolin) seems to have proceeded somewhat radially from the quartz. A second sample was similar to the first but coarser grained, stained with limonite and somewhat weathered. It shows surface weathering also. Kaolin is the chief product of alteration and weathering." The cone deformation point varied from cone 6 when the samples were low in quartz to cones 11 and 12 when the quartz content was high.

Yale, British Columbia. A very large deposit of feldspathic rock outcrops along the west side of the Fraser River between the towns of Yale and Hope. In this locality the river runs south. Numerous sections are to be seen in the cuts made by the Canadian Pacific Railway and fresh slides reveal the white rock high up on the sides of the hills to the west for a distance of about nine miles along the track between mile posts number 29 and 38. The feldspar has intruded basic igneous rocks which can be seen on either side of the main body in the railroad cuts. The structure is very irregular and the mass is filled with epidote spots in variable amounts which give a spotted pale green color to the rock in place. Samples of this feldspar show almost pure albite with about 5 per cent anorthite. The material is highly altered with sericite, kaolin and quartz as the secondary minerals. It was not found east of the river in the cuts of the Canadian National Railway.

A white sample from Emory Creek deformed at cones 7 to 8. Darker samples containing more iron silicates may fuse as low as cone 4. Considerable gas action is noted during fusion. In such a large mass of comparatively clean feldspathic rock, it is expected that further prospecting will reveal feldspar pure enough for commercial whiteware. The outcrops visited were not pure enough for whiteware but could be used as fluxes in buff or darker firing bodies.

Douglas Channel, British Columbia. Pink microcline feldspar is found in the Drum Lummon copper mine on Douglas Channel, west coast of British Columbia. Some samples show small spots of green salts.

Volcanic Tuff and Ash. Very large deposits of volcanic ash and tuff are found in both Oregon and Washington, principally east of the Cascade Mountains. The greater part of these fuse at very low temperatures to black glass. However, in a few the iron content is low enough to produce nearly white glass when fused. Such materials may in the future have some economic value for light colored glaze and body work.

(Continued from Page 50)

of distilled water at a much lower cost than for distillation; and experience in a number of scientific and technical fields has shown that the water purified by electro-osmosis may be used satisfactorily to replace distilled water.

Fate of Grease in Sludge Digestion

S. L. Neave and A. M. Buswell discussed this subject before the Division of Water Sewage and Sanitation Chemistry on Thursday, April 14th. It has been recently shown that the percentage of grease (mainly calcium soaps) in digesting sewage sludge remains practically constant; since, however, digestion decreases the total solid matter by about 30 per cent, it follows that an equivalent amount of grease must be liquefied also. The present paper reports laboratory experiments in which sludge was digested in the acid range of hydrogen-ion concentration to minimize proteolysis and cellulose degradation, and the grease digestion followed by weekly degerminations of petroleum ether extract on the dry solids, lower fatty acids in the liquid phase and gaseous products from the process. In a period of nine weeks the total solids decreased by 26 per cent, and the organic matter by 30 per cent. The grease decreased by 70 per cent and this loss was quantitatively represented by the sum of the volatile fatty acids plus the gaseous products. A typical gas was evolved containing 75.8 per cent methane. Changes in the nitrogen cycle were slight and no change was found in the cellulose content of the solids. The idea is advanced, therefore, that in the acid-digestion process and probably also in the normal alkaline one, calcium soaps digest readily to calcium acetate as the main product, and some of this in turn further ferments to methane and carbon dioxide.

The resultant sludge in these experiments was not well digested on account of inhibited proteolysis; the addition of lime to one series slightly accelerated liquefaction but increased the final weight of digested sludge.

Absorption of Nitrogen Oxides in Phosphate Rock Suspension

V. N. Morris of the research laboratory of the Bureau of Soils discussed this subject before the Industrial Division on Tuesday, April 12th. Nitrogen oxides, in concentrations of 10 per cent or less, have been absorbed in suspensions consisting of phosphate rock in water and in various nitric acid solutions. The oxides are thus converted very largely into calcium nitrate, and the phosphate into the water-soluble form. The addition of phosphate rock to the absorbing solutions, particularly in cases where a considerable concentration of nitric acid has been built up, increases the degree of absorption of nitrogen oxides, unless the rock is added in too large an amount.

The substitution of either calcium nitrate or mono-calcium phosphate for an equivalent quantity of nitric acid in the absorbing solution results in an improvement in absorption. Solutions of these salts up to certain concentrations are also better absorbers than is water alone.

Conference of Safety Groups

The Northwestern Pennsylvania Regional Safety Conference will be held in Erie, Pennsylvania, May 17. Organizations taking part are the Erie Safety Council, National Safety Council, Manufacturers Association, Chamber of Commerce and other prominent groups. Mayor Williams of Erie will greet the delegates.

Although Walter Duff, New Castle Lime and Stone Company, will make the only speech which directly treats of safety work in the quarry industry, delegates from that industry will find other talks on the program of more than casual interest. J. M. Sandel, for example, is scheduled to summarize safety activities in Pennsylvania, while Albert N. Richardson, as Editor of the General Electric Coupler, can speak with authority about the value of plant publications in safety work. George Sims, Secretary, The Sims Company, will tell how head and eyes have been protected in his shops.

More than Two Million Transfers in Real Estate Possible in 1927

Sales activity in real estate throughout the country has been studied by the National Association of Real Estate Boards. The study covers the period 1917 to 1926 and reveals a continuous increase in the number of transfers of property or sales year by year with the exception of 1918 and 1921. The number of sales were highest during 1926. The figures studied cover 41 principal cities and are unusually complete.

In 1926 approximately 1,852,000 real estate transfers were reported while only 757,000 were reported in 1917. The number reported annually passed the one million mark in 1919 and has remained above since. Indications are that there will be more than two million transfers during 1927.

Transportation of Concrete

In Germany new machines have been constructed and are in use by means of which concrete is transported by pneumatic pressure in building construction. (E. Fraenckel, 30 General Meeting German Concrete Society, March, 1927.)

PIT AND QUARRY FOREIGN DIGEST

Portland Cement Burning Factors

1. Appreciable strength is obtained when burning under rotary kiln conditions only when the temperature exceeds 1,275 degrees C., (about 2,300 degrees F.). Under this temperature strength may be obtained in the finished product only by excessively long sintering periods.

2. Above this temperature, maintaining all other conditions constant, the fluctuation of strength is unimportant, and sintering temperatures higher than 1275 degrees C. have only a slight influence upon the strength of the product.

3. The time of burning has a greater influence. At the normal burning temperature, 1,400 degrees C. (2,550 F.), the strength of the product gradually increases, and after a definite period reaches a maximum. The optimum burning period appears to vary with different cements.

4. Quenching in part improves the strength and in part also decreases it, so that the customary viewpoint that rapid cooling of the clinker must unquestionably improve the quality of the cement cannot be maintained. At the same time very slow cooling has an unfavorable effect.

5. The clinker burned under the temperature of 1,275 degrees C., under the other usual conditions for rotary kilns does not disintegrate readily. This is effected only by extension of the burning period. E. Ullrich (Zement, March 10, 1927. p. 181-184).

Spray Gun for Stucco

A spray gun for dry or moist materials such as stucco is based upon the principle of centrifugal force. It consists of a hopper to hold the material and which contains an agitator to keep it uniform. This hopper feeds a small turbine operated by a direct connected motor. The grout is forced out at the side opening in the turbine casing at considerable pressure. The whole apparatus is suspended by light block and tackle alongside the work and operated easily by one man. D. Seemueller (Zement March 10, 1927. p. 188-190).

Pile Driving

The tendency of pile driving methods is along the lines of eliminating those resistances which impede driving without assisting the ultimate bearing capacity, and augmenting those which are of a more useful kind. All of these methods entail vibration in the operation of driving, and future developments are likely to be in the direction of driving without vibration. This has been successfully accomplished by a method of driving by pressure instead of by impact. The difficulty is, of course, to provide the necessary resistance to the enormous downward thrust required; but this could often be supplied by needling existing structures, anchorages to piles already driven, or by anchorages to dead weights in self-contained equipment. Such a method has the advantage that the actual bearing capacity of the pile is definitely determined, and in conjunction with a water-jet is considered to be the ideal method wherever pile driving operations have to be carried out in the neighborhood of existing buildings. Gower Pimm (as reported by the Structural Engineer, London, March, 1927. p. 93-94).

Non-Plastic Materials Made Plastic

In the production of refractory, acid-proof, and like ceramic products from non-plastic substances, a small proportion of the raw material is converted into a colloidal solution to act as a binding means for the remaining material which is in granular form, the proportions being so regulated that a slightly plastic mass capable of being molded by stamping or pressing is produced. Scheidhauer & Giessing Akt. Ges. (British Patent 264, 192).

Lithopone

Lithopone or zinc sulphides obtained when zinc liquors are precipitated with barium sulphide or sodium sulphide respectively are rendered fast to light by treating the purified zinc solution with an alkaline or alkaline earth phosphate or silicate prior to the precipitation. The phosphate or silicate remains incorporated in the lithopone or zinc sulphide. W. Carpmael (British Patent 264, 223).

Screening Apparatus

A screen for grading or sorting minerals, etc., consists of spaced rods or bars arranged into two parallel series in different planes, the bars in one series being disposed intermediate the bars in the other series. The material is conveyed over the screen by a number of time-carrying bars mounted on endless chains and means are provided for varying the distance between the bars in the upper series so as to vary the size of the grading openings. C. A. and R. C. Pessell (British Patent 264, 253).

Attachments to Concrete

A device for fastening concrete slabs or other members to concrete structures, comprising sockets of spirally wound wires, which have projecting anchoring loops, and are imbedded in the structure for receiving threaded bolts. The loops, formed at intervals in the length of the wire socket are twisted to obtain a close fitting socket and firm anchorage in the concrete. The socket is made from a single piece of wire wound round a screw, the whole being embedded in the concrete and the screw withdrawn when the concrete has set. I. Gardner (British Patent 264, 254).

Fibrous Sheets and Slabs

Laminated sheets, slabs, boards and the like are made by pasting together, for example with starch paste, a number of layers of felted fibres containing zinc oxide, and subjecting the product to the action of a soluble zinc salt or substance such as hydrochloric acid, to produce an insoluble basic zinc salt. The rate of setting may be modified by the addition of retarders such as boric acid, or accelerators such as aluminum salts. In an example, felted sheets containing 20 parts of zinc oxide to 100 parts of asbestos, are pasted together, and subjected to the action of a zinc chloride solution of 35 degrees Bé containing 1¼ parts of boric acid to 100 parts of solution. The laminated structure may be rolled or pressed to increase its density or hardness. A. E. Hills (British Patent 264, 583).

Characteristics of Silicate Rocks From Added Oxides

Addition to silicate rocks were made of the following substances: CaO, Al_2O_3, Fe_2O_3 in amounts of 2.4 and 6% as well as 2 to 3%. Simultaneously corresponding quantities of calcium fluoride were added to other rock portions in order to determine the specific influence of the oxides. The influence upon the following characteristics were investigated: the true specific gravity, microscopic structure, thermal expansion to 750 and 1,000 degrees C., porosity, mechanical strength in cold state, and softening temperature under a load of one kilogram per sq. cm. The starting material was Hessian quartz with a silicon dioxide content of 97.5 per cent. The results found were: The true specific gravity was in all cases greater than the gravity of the ignited starting material, very likely because the oxide added, as well as the possible reaction products with the silica mass, possess a higher specific gravity than the transformation variety of quartz. Thin sections showed that with rising lime content the quartz transformation was aided. When calcium fluoride was substituted for lime, the temperature of the quartz transformation was raised somewhat; in both cases the calcium remained in the ignited rock as metasilicate. Iron oxide either alone or with lime exerted a very favorable effect upon the quartz transformation. But Al_2O_3 instead of an accelerating effect, retarded the formation of crystoballite and tridymite; the presence of a 2-3 per cent of iron oxide exerted only a very slight retarding effect on the transformation. The thermal expansion curve up to 1,000 degrees C. exhibited, with the alumina rich mixtures, besides a sharply defined cristoballite effect at 230 degrees C., mostly the quartz effect at 575 degrees, whereas the iron rich tests showed a tridymite and crystoballite effect between 100 and 300 degrees but no more quartz effect. The results of the mechanical strength tests in the cold, showed that the lime additions practically did not affect the strength at all, whereas calcium fluoride exerted a marked weakening and increased the voids to 19 volume per cent.

The highest strength value was exhibited by the iron oxidesilica rock mixture, namely 760 kg. per sq. cm. Alumina caused a decided fall in strength values and an increase in porosity. The softening temperature under a load of 1 kg. per sq. cm. remained unchanged with a rising lime content up to 6 per cent, and similarly with iron oxide it was hardly affected, whereas with rising alumina content the softening temperature was lowered, 6 per cent of alumina giving a softening point of only 275 degrees C. K. Endell and R. Harr. (Stahl. u. Eisen, Volume 46, p. 1870-76.)

Removal of Iron from Clays, Etc.

The removal of iron from clays, bauxite, etc., is effected by the sulphurization of the iron and the dissolving away of the iron sulphide thus formed with acids. The sulphurizing is performed by the action of hydrogen sulphide gas at ordinary temperature, with subsequent decomposition of the iron sulphide thus formed by sulphur dioxide in the gaseous state. Hans Fleissner (German Patent 439, 033).

Refractories for Gas Heated Kilns

Refractories suitable for gas heated kilns are formed by means of covering a form made of wire with a mass composed of water glass and asbestos meal with the addition of fire proof materials such as chamotte powder, magnesia, etc., either alone or mixed. Otto Misch (German Patent 439, 284).

Concrete Dams

Multiple arched dams have been found very durable in Switzerland. If the calculations are made according to the laws of the theory of elasticity, and if account is taken of the temperature variations and, where necessary, of the pressure exerted by ice, it is highly probable that a dam, safe and impermeable will be obtained by the multiple arch principle of construction, provided, of course, that careful hand labor and accepted construction methods are used. So far as the construction cost and relative strength are concerned, the multiple arch dams are generally superior to the gravity type. (Ekwall-Le Ciment. March, 1927. 95-98.)

Waterproof Cement

Stone flour or powdered mineral matter is mixed to a creamy fluid with water, the mixture is boiled, and liquid bitumen or mineral wax is added with agitation, until a pasty mass is obtained, forming an elastic waterproof cement on cooling. R. Illemann (British Patent 262, 961).

Some Don'ts When Blasting

Speaking before the Quarry Safety Conference at Toledo April 8, J. Barab, Hercules Powder Company, Wilmington, Delaware, enunciated the following precautions for handling explosives.

Blasting Caps. No blasting caps, or other detonating or fulminating caps, or detonators, shall be kept or stored in any magazine in which other explosives are kept or stored.

Do not open a box of blasting caps or case of explosives near an open light, or in direct line with an air current or any place where sparks might fall onto the box.

Do not leave loose high explosives, black powder, or blasting supplies exposed in any magazine.

Do not pile damaged or unsalable explosives with salable stocks.

Do not store any explosives where they are likely to get wet or absorb moisture.

Do not keep or use any style of metal tools in a magazine or store any commodities except explosives in the magazine.

Do not open packages of explosives or pack or repack explosives in a magazine or within fifty feet of a magazine.

Do not leave explosives especially blasting caps and electric blasting caps lying around where children, people or live stock can meddle. Always keep them under lock and key in a suitable magazine.

Do not store any explosives in a dwelling, blacksmith shop, barn or any place where in event of an accident, loss of life or property damage might result.

Do not store fuse in a hot or damp place. Fuse should be kept cool and dry.

Do not handle fuse carelessly in cold weather for when cold it is stiff and breaks easily. It should be warmed slightly beforehand.

Do not use a magazine for a thawing house.

Do not store primed cartridges in a magazine, that is, cartridges with detonators attached.

Do not try to take a blasting cap from a box with a wire or nail or by inserting any other sharp instrument.

Do not fasten a blasting cap to the fuse with the teeth or with a knife; use a cap crimper.

Do not try to open an electric blasting cap or pull the wire out of it.

Do not carry or transport blasting caps or electric blasting caps with other explosives. Keep them away from each other till ready to prime the cartridge.

Do not smoke in the vicinity of explosives or when handling or using explosives.

Do not have matches about you when handling explosives.

Post magazine rules in every magazine and comply with them.

Salaries Pay One-third of Income Tax According to Treasury Department

More than one-third of the combined income of individual taxpayers in the United States in 1925 was derived from wages and salaries, according to a detailed analysis of individual returns for that year recently made public by the department of the treasury. The statistics, compiled by the Bureau of Internal Revenue, disclosed, however, that no group of the 13 income classes bracketed by the Revenue Act of 1926 received more than 67 per cent of its total income from the wage and salary source alone.

Next to wages and salaries as income producers were incomes from "business" and "dividends," in that order, with an average for all classes of 15.38 per cent from the former and 13.64 per cent from the latter, the Bureau's figures showed. Profits from sales of real estate, stocks and bonds and other comparable assets resulted in a combined income of 8.02 per cent of the total individual income of the country.

The 207 taxpayers whose incomes were $1,000,000 or more for the year covered by the analysis made half of their net income from "capital net gain and the sale of assets held more than two years." An additional 30 per cent of the total income derived from wages and salaries amounted to only 1.68 per cent of the total they received. The bracket of taxpayers having incomes from $100,000 to $150,000 received greater percentage of their total from dividends than any other class—34.69 per cent, but the bracket from $500,000 to $1,000,000 ran a close second with 34.48 per cent.

Wages Steadily Advance

Wages of industrial workers are advancing steadily throughout the United States. This is seen from a study of the average weekly earnings per worker in principal industries covering the years 1921 to 1926 covering more than twenty lines of manufacturing and including the wages of men and women, both skilled and unskilled workers.

The average earned weekly per male worker has advanced from $25 in 1921 to $30 in 1926. The average earned weekly per woman worker advanced from $16 to $17 for the same period. All of the advance occurred between 1922 and 1923. Since 1923 the average of the women has not advanced. The male workers' wage has been increasing more rapidly than the wages of women.

There are two factors to be considered in this study. First, male workers are more completely unionized than women. Second, new machinery is now doing work formerly done by women in very many processes.

DISTRIBUTION OF CEMENT

Portland cement shipped from mills into States in January and February, 1926 and 1927, in barrels*

Shipped to	January 1926	January 1927	February 1926	February 1927
Alabama	129,291	132,569	145,636	127,020
Alaska	165	0	264	132
Arizona	38,869	54,088	28,956	41,677
Arkansas	46,708	46,014	55,984	59,309
California	931,238	998,230	714,783	649,302
Colorado	29,203	28,050	51,068	45,006
Connecticut	40,300	34,587	29,323	58,534
Delaware	9,019	11,170	6,437	13,885
District of Columbia	35,304	50,552	47,086	59,964
Florida	483,824	283,031	445,674	285,604
Georgia	80,129	119,770	86,417	134,787
Hawaii	10,757	22,491	15,830	31,022
Idaho	19,198	15,085	19,524	27,495
Illinois	323,947	301,829	429,654	417,054
Indiana	85,724	74,589	121,253	143,650
Iowa	28,439	38,157	50,077	55,837
Kansas	56,598	68,122	114,296	107,823
Kentucky	35,560	42,851	56,249	78,183
Louisiana	65,695	116,633	84,706	122,629
Maine	20,310	6,295	19,084	5,422
Maryland	85,495	135,015	77,537	123,421
Massachusetts	101,212	70,354	57,390	81,457
Michigan	222,061	258,848	253,661	301,666
Minnesota	66,063	41,396	72,714	61,047
Mississippi	44,140	51,325	47,179	62,783
Missouri	137,343	113,581	202,914	173,365
Montana	9,716	7,261	9,867	9,845
Nebraska	23,788	22,675	49,054	39,594
Nevada	2,508	2,724	5,754	3,649
New Hampshire	17,081	16,172	12,750	9,599
New Jersey	257,544	227,489	163,588	279,739
New Mexico	12,019	12,503	14,308	20,957
New York	592,584	† 700,414	434,323	855,484
North Carolina	81,764	141,582	139,656	168,720
North Dakota	3,338	3,575	4,903	3,081
Ohio	220,728	226,786	250,265	321,218
Oklahoma	101,087	164,266	167,043	191,130
Oregon	53,995	35,715	58,991	53,310
Pennsylvania	423,443	† 365,107	351,940	476,001
Porto Rico	0	2,550	0	1,275
Rhode Island	18,409	19,352	10,166	19,874
South Carolina	44,723	42,537	56,022	47,821
South Dakota	6,413	5,094	18,848	10,170
Tennessee	66,379	86,485	86,871	102,871
Texas	270,231	362,004	364,107	371,525
Utah	10,655	13,356	15,613	15,527
Vermont	2,072	5,606	1,640	4,472
Virginia	61,645	62,199	77,572	92,723
Washington	72,393	104,608	77,936	124,266
West Virginia	39,983	47,871	45,121	64,296
Wisconsin	60,400	76,148	80,066	100,245
Wyoming	5,797	5,972	11,710	7,754
Unspecified	17,254	† 19,886	† 20,827	18,914
	5,602,541	5,894,569	†5,762,637	6,682,134
Foreign Countries	71,459	73,431	† 57,363	48,866
Total shipped from cement plants	5,674,000	5,968,000	5,820,000	†6,731,000

*Includes estimated distribution of shipments from three plants in January and February, 1927; and from four plants in January and February, 1926.
†Revised.

Production, shipments, and stocks of finished Portland cement, by districts, in March, 1926 and 1927, and stocks of barrels, in February, 1927*

Commercial District	March Production 1926	March Production 1927	March Shipments 1926	March Shipments 1927	Stocks at end of March 1926	Stocks at end of March 1927	Stocks at end of February 1927*
Eastern Pa., N. J., & Md.	3,032,000	2,997,000	2,416,000	3,081,000	5,732,000	5,677,000	5,761,000
New York	374,000	597,000	335,000	481,000	1,629,000	1,568,000	1,453,000
Ohio, Western Pa., and W. Va.	626,000	1,265,000	679,000	925,000	2,739,000	3,283,000	2,942,000
Michigan	223,000	551,000	390,000	596,000	1,780,000	1,975,000	2,019,000
Wis., Ill., Ind., and Ky.	1,208,000	1,290,000	942,000	1,187,000	3,966,000	3,341,000	3,239,000
Va., Tenn., Ala., and Georgia	1,241,000	1,201,000	1,189,000	1,220,000	1,111,000	1,178,000	1,197,000
Eastern Mo., Ia., Minn. & S. Dak.	744,000	714,000	724,000	729,000	3,087,000	3,226,000	3,241,000
Western Mo., Neb., Kan. & Okla.	848,000	753,000	760,000	725,000	1,487,000	1,584,000	1,556,000
Texas	452,000	465,000	403,000	492,000	536,000	448,000	475,000
Col., Mont., Utah	142,000	118,000	191,000	138,000	308,000	462,000	482,000
California	1,259,000	1,196,000	1,264,000	1,196,000	501,000	704,000	704,000
Oregon and Washington	241,000	305,000	246,000	313,000	360,000	484,000	491,000
	10,390,000	11,452,000	9,539,000	11,083,000	23,236,000	23,930,000	23,560,000

*Revised.

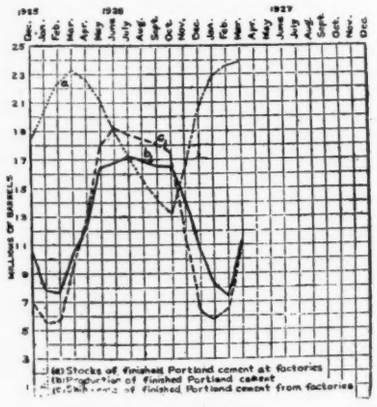
Domestic hydraulic cement shipped to Alaska, Hawaii, and Porto Rico, in February, 1927†

	Barrels	Value
Alaska	416	$1,315
Hawaii	18,723	45,339
Porto Rico	6,575	16,395
	25,714	$63,049

†Compiled from the records of the Bureau of Foreign and Domestic Commerce and subject to revision.

MARCH CEMENT STATISTICS

March production and shipments of Portland cement were the greatest for that month in any year, according to the Bureau of Mines, Department of Commerce. Production shows an increase of over 10 per cent, and shipments an increase of more than 16 per cent, as compared with March, 1926. Portland cement stocks at the end of March, 1927, are 3 per cent in excess of the stocks at the end of March, 1926, and are the greatest at



the end of any month in the history of the industry.

Production and shipments of Portland cement for the first quarter of 1927 show increases respectively of 4 and 13 per cent over the corresponding period in 1926.

The output of a new plant located in Alabama, is included for the first time in these statistics, which are prepared by the Division of Mineral Resources and Statistics of the Bureau of Mines and are compiled from reports for March, 1927, received direct from all manufacturing plants except five, for which estimates are necessary on account of lack of returns.

E. H. Sager Joins Foote Bros.

Mr. E. H. Sager, formerly Chicago representative for the Ajax Flexible Coupling Company, has recently joined the sales force of Foote Bros. Gear & Machine Company, and is now assigned to territory in the State of Michigan.

Combustion Engineering Corporation, Ladd Water Tube Boiler Company, and Heine Boiler Company have consolidated their Cleveland district offices and will now be located at 1107 Guardian Building. Mr. Frank Henderson is Cleveland district manager of these three associated companies.

Production, shipments, and stocks of finished Portland cement, by months, in 1926 and 1927, in barrels

Month	Production		Shipments		Stocks at end of month	
	1926	1927	1926	1927	1926	1927
January	7,887,000	8,258,000	5,674,000	5,968,000	20,582,000	22,914,000
February	7,731,000	*7,377,000	5,820,000	*6,731,000	22,385,000	*23,560,000
March	10,390,000	11,452,000	9,539,000	11,083,000	23,236,000	23,930,000
1st quarter	26,008,000	27,087,000	21,033,000	23,782,000	.....	.....
April	12,440,000	.....	12,965,000	.....	22,710,000	.....
May	16,510,000	.....	17,973,000	.....	21,255,000	.....
June	16,866,000	.....	19,134,000	.....	19,000,000	.....
2nd quarter	45,816,000	.....	50,072,000	.....	.....	.....
July	17,134,000	.....	18,812,000	.....	17,301,000	.....
August	16,995,000	.....	18,583,000	.....	15,718,000	.....
September	16,571,000	.....	18,087,000	.....	14,188,000	.....
3rd quarter	50,700,000	.....	55,482,000	.....	.....	.....
October	16,596,000	.....	17,486,000	.....	13,334,000	.....
November	14,193,000	.....	11,276,000	.....	16,243,000	.....
December	10,744,000	.....	6,432,000	.....	20,616,000	.....
4th quarter	41,533,000	.....	35,194,000	.....	.....	.....
	164,057,000	.....	161,781,000	.....	.....	.....

*Revised.

EXPORTS AND IMPORTS*

Exports of hydraulic cement by countries, in February, 1927

Exported to	Barrels	Value
Canada	1,933	$ 6,637
Central America	12,322	31,287
Cuba	8,474	21,582
Other West Indies and Bermuda	10,146	24,411
Mexico	8,547	25,821
South America	26,731	105,257
Other countries	3,251	18,990
	71,404	$233,985

Imports of hydraulic cement by countries, and by districts, in February, 1927

Imported from	District into which imported	Barrels	Value
Belgium	Florida	12,600	$ 21,188
	Georgia	15,000	23,209
	Massachusetts	26,350	32,433
	New Orleans	7,741	11,655
	New York	1	3
	Porto Rico	11,503	23,010
	San Francisco	6,015	8,168
	South Carolina	4,495	6,006
	Total	83,705	$125,672
Canada	Maine and New Hampshire	70	268
	Saint Lawrence	975	1,809
	Ttoal	1,045	$ 2,077
Denmark and Faroe Islands	Porto Rico	38,148	$ 59,525
France	New York	500	$ 1,067
Norway	New York	1	5
	Philadelphia	998	1,209
	Total	999	$ 1,214
United Kingdom	Massachusetts	1,500	2,485
	Porto Rico	4,524	8,640
	Total	6,024	11,125
	Grand total	130,421	$200,680

Exports and imports of hydraulic cement, by months, in 1926 and 1927

Month	Exports				Imports			
	1926		1927		1926		1927	
	Barrels	Value	Barrels	Value	Barrels	Value	Barrels	Value
January	72,939	$ 216,431	75,346	$254,072	360,580	$ 576,717	193,175	$269,661
February	73,975	220,706	71,404	233,985	314,118	527,948	130,421	200,680
March	69,080	205,647	.....	.....	493,241	812,968	.....	.....
April	96,296	284,772	.....	.....	257,302	398,114	.....	.....
May	78,601	224,365	.....	.....	223,130	337,031	.....	.....
June	80,684	248,814	.....	.....	335,570	495,744	.....	.....
July	130,822	370,220	.....	.....	250,862	395,981	.....	.....
August	64,946	216,489	.....	.....	350,638	560,532	.....	.....
September	70,920	239,174	.....	.....	194,129	308,224	.....	.....
October	69,389	225,874	.....	.....	263,403	386,335	.....	.....
November	76,598	238,103	.....	.....	55,233	82,949	.....	.....
December	89,976	305,238	.....	.....	151,850	246,293	.....	.....
	974,226	$2,995,833	.....	.....	3,250,056	$5,128,836	.....	.....

*Compiled from the records of the Bureau of Foreign and Domestic Commerce and subject to revision.

Alamo Engines

The Alamo Engine Company manufacture a line of engines which comprise horizontal type in sizes 1½ to 16 horsepower and in two cylinder vertical type in sizes 6 to 9 horsepower. Some of the specifications for the horizontal type are as follows. The connecting rod is malleable iron, I beam construction of ample strength for the service demanded from it. Valves are 3½ per cent nickel steel stems with cast iron disks shrunk and riveted on the stems. The fuel tank is made of galvanized iron with its joints locked and soldered and is located in the engine base.

All engines below 10 horsepower in size are equipped with sight feed, ball check oilers on cylinder and grease cup on connecting rods and main bearings. Engines 10 horsepower and larger are equipped with the wick wipe oil system. A high tension magneto is furnished with the engine. Cooling of the engine is by means of the hopper system. The cylinder head is water cooled and provision is also made in the head of a full water jacket to cool the valves. The governor is of the hit and miss type. The crank shaft is a steel forging, ground and polished with a 6-inch extension on the pulley side. A speed changer is provided so that a range of speeds can be obtained while the engine is running.

The two cylinder vertical type has been made by this company since 1908 and is designed where a light, compact power plant is required. It carries a horsepower rating of 6 to 9, depending upon the speed at which the engine is operating. Some of its specifications are as follows: Lubrication is by the positive pressure system to all main bearings and splash system on connecting rod bearings. Each connecting rod has a separate oil trough to give the desired lubrication. The oil pump, which is of the plunger type, is located in the lower crank case and driven from the cam shaft. A centrifugal type governor is used which is fully enclosed with external speed adjustment, allowing the engine speed to be changed while machine is in operation. The carburetor, with a single Venturi compound nozzle, is attached to the hot spot manifold and the butterfly valve is operated by the governor. A thermo system of cooling is used, the radiator is of liberal size complete with a self-oiling fan which is belt driven. The magneto is a high tension, operated at engine speed, equipped with impulse starter and coupling for timing the engine.

New Incorporations

South Lakewood Sand & Gravel Co., Inc., Chas. Peterson, Jr., Pres., South Lakewood, N. J. 500 shares no par.

U. S. Phosphoric Products Corp., A. A. Case, Gen. Mgr., East Tampa, Fla. $1,000,000. Bought holdings of U. S. Export Chemical Co. at East Tampa, and will erect new plant with approximate capacity of 100 tons of acid phosphate and 150 tons of gypsum daily.

Clear Lake Sand & Gravel Co., 719 N. Grand Ave., West Springfield, Ill. $15,000. Pump, extract and produce sand, gravel, and crushed rock for commercial purposes. Edgar M. Clark, C. B. Denkert, Henry Wenneborg.

Kellotto Products Co., 11 S. La Salle St., Chicago, Ill. 1,000 shares n. p. v. Marble, granite, and stone. Otto Kell, Wm. D. Hardee, Albert L. Norman, Wallace Davis. (Cor., Bartel & McCormick, 11 S. La Salle St.)

Ulster Davis, Inc., 6 Aiken Ave., Rensselaer, N. Y. Boating business, sand, gravel, stone, etc. $200,000.

Daykold Asphalt Co., Carson City, Nev. $135,000.

Victory Gravel Co., Shreveport, La. Will open branch office at Texarkana, Ark.

Merrill Marble & Granite Works, Inc., Merrill, Wis. $20,000. A. E. Anderson, Lillian Anderson, H. J. Mitbauer.

Lensch Sand & Gravel Corp., Yonkers, N. Y.

Tuckahoe & Patterson Marble Corp., Tuckahoe, N. Y. $50,000. Giuseppe Longobardi, Alfred Rogliano, Tuckahoe Frank Braculello, Scarsdale.

Lego Marble Corp. $20,000. (S. L. Lewine, 1440 Broadway, New York City.)

Tidewater Gravel Corp., Richmond, Va. $300 to $50,000. Sherlock Bronson, Pres.; D. J. Mays, Sec.; M. L. Waddill, all of Richmond. To mine, manufacture, and prepare for market sand and gravel.

Midland Gypsum Co., Billings, Mont. $100,000. Fred Whiteside, Great Falls; G. C. Thompson, Billings; Fred Soular, Bridger.

Cox Lime, Stone & Lime Products Corp., Wilmington, Del.

Santa Fe Lime Rock Corp., Gainesville, Fla. J. W. Geller, R. E. Gulledge, R. O. Hanson. 500 shares, par value $100.00 each.

Miller Lime Products Co., Hudson, N. Y. $125,000.

Edward Lutz Sand & Gravel Co., Milwaukee, Wis. $80,000, 800 $100 shares. Edward Lutz, Otto Lutz, Alfred Berglund.

Saffold Gravel Co., Leesburg, Fla. $12,000, 120 shares, $100 each. R. J. Tuller, Knox Burger, A. A. Griffin.

Bloomer Burkestone, Inc., Dover, Del. $500,000.

C. G. Hedges, Dalles, Ore. $10,000. Will build rock crushing plant with daily capacity of 200 yds.

Sands Production Co., Cleveland, O. 500 shares n. p. v. J. Friedman, Esther P. Silverman, Rebecca Bonstein, L. I. Friedman, Wm. Uson.

Edward C. Barta Co., 4636 N. Crawford Ave., Chicago, Ill. $10,000. To mine, quarry, and excavate for stone and rock. E. C. Barta, Frank Lychamer, Harry B. MacLeod.

Mississippi Concrete & Material Co., Jackson, Miss. $20,000. J. H. Thompson, M. L. Zehnder.

Standard Silica Corp., Wilmington, Del. (Lawyers Corp Co.) $100,000.

Acme Sand & Gravel Co., Albany, N. Y. $2,000. C. O. Eaton, H. and G. M. Shapiro.

Christner Gravel & Construction Co., Elkhart, Ind. $20,000. Lester Truex, Charles F. Christner, Paul Christner.

Cadot Sand Co., Columbus, O. $25,000. O. E. G. Winn, C. S. Heiston, C. E. Gwinn, H. L. Cadot, W. H. Sharp.

Independent Crushed Stone Co., Jacksboro, Tex. $30,000. W. T. Spivey, E. A. Gwaltney, W. W. Hyde.

Tulsa Stone & Gravel Co., Tulsa, Okla. $10,000. A. F. House, Gertrude House, Tulsa; E. R. Jone, 706 Surety Bldg., Muskogee.

Hammond Gravel Co., Hammond, La. Harry A. Black, Charles Black, J. E. Rogers.

Riverside Quarries, Pasadena, Calif. N. J. Shupe, Pasadena; Charles A. Goodale, Perris; Robert L. Newby, Pasadena. 750 shares common, n.p.v. Producers of slate, flagstone and granite.

Bergen Sand & Gravel Co., East Paterson, N. J. $125,000. C. and A. L. Roth, L. F. Fournier. (Filed by James H. Whiten, Hackensack.)

Argentine Onyx Corp., Manhattan, N. Y. $100,000. Onyx and marble quarries. Harold A. Coban, 220 Broadway, New York City.

Hawkeye Material Co., Iowa City, Iowa. $50,000. Sand and gravel. C. E. Thomas, Pres.; Noah H. Falb, Sec.

Lime Produce Co., Lima, O. $5,000. Chris Lora, F. B. Beade, Guy D. Means, R. P. Smith, Neal L. Lora.

Recent Patents

The following patents of interest to readers of this journal recently were issued from the United States Patent Office. Copies thereof may be obtained from R. E. Burnham, patent and trade-mark attorney, Continental Trust Building, Washington, D. C., at the rate of 20 cents each. State number of patent and name of inventor when ordering.

1,620,982. Comminuting mill. Ray C. Newhouse, Chicago, Ill., assignor to Allis-Chalmers Mfg. Co., same place.

1,621,563. Form for concrete structures. Frank W. Stevens, Newton, Mass.

1,621,564. Separator. Thomas J. Sturtevant, Wellesley, Mass., assignor to Sturtevant Mill Co., Boston, Mass.

1,621,571. Pulverizer. Henri E. Witz, Rheinland Baden, Germany, assignor to Babcock & Wilcox Co., Bayonne, N. J.

1,621,695. Grizzly. Frank J. Tuite and Gordon F. Dodge, New York, N. Y., assignors to Robins Conveying Belt Co., Passaic, N. J.

1,621,775. Mill. William W. Gibson, Alameda, Cal.

1,621,949. Vibrating screen. Gustave A. Overstrom, Pasadena, Cal.

1,622,239. Dipper-operating mechanism for excavating machines. Philo A. Orton, Chicago, Ill., assignor to Orton Crane & Shovel Co., Huntington, Ill.

1,622,305. Screen. John Bland, Chicago, Ill.

1,622,337. Kiln for burning cement. Carl Naske, Berlin - Charlottenburg, Germany.

1,622,528. Bracket for concrete-floor forms. Edward C. Marqua, Kansas City, Mo.

1,622,565. Flow-facilitating means for gravity hoppers. Robert H. Beaumont, Radnor, Pa., assignor to R. H. Beaumont Co., Philadelphia, Pa.

1,622,568. Method and apparatus for river control. Edward Bignell, Lincoln, Neb., assignor to Concrete Piling Co., Seward, Neb.

1,622,695. Impact pulverizer. Alfred B. Willoughby, Philadelphia, Pa.

1,622,823. Scraper-loading apparatus. Edward J. Doberstein, Chicago, Ill., assignor to Goodman Mfg. Co., same place.

1,623,040. Method and apparatus for grading solid materials. George R. Baker and William E. Prescott, London, and Charles W. Gilderdale, New Earswick, England, assignors to Rowntree & Co., Ltd., York, England.

1,623,090. Reinforced concrete paving. George D. Burr, Seattle, Wash.

1,623,151. Concrete form. Fred Wusholtz, Claytonville, Ill.

1,623,194. Excavating machine. Francis C. Marshall, Green Bay, Wis.

1,623,252. Means for reenforcing concrete floors. Otto Konrad, Oshkosh, Wis.

1,623,417. Pavement. Frank V. Lanham, Dallas, Tex.

1,623,743. Machine for distributing sand and the like. Thomas F. McGuiness, Portland, Me.

1,623,985. Concrete-block composition. Maximilian E. von Mach, jr., Detroit, Mich.

INTIMATE NEWS OF MEN AND PLANTS

Large Asphalt Merger

What is reported to be the largest producers of asphalt in the world, under one corporate, was recently effected by the consolidation of rock asphalt properties in Kentucky and Alabama. The new corporation will be known as the United Rock Asphalt Company and William E. Massey is chairman of the Board of Directors.

All the properties of the Rock Asphalt Company of America, of which Mr. Massey is president, are going into the new company. The properties of this company consist of a new, modern, electrically equipped plant on Green River in Edmondson County, with a capacity of 2,000 tons a day, a plant at Decatur, Alabama, and one at Black Rock, Kentucky. The capacity of these three plants will be 3,000 tons a day which it is said will be the world's largest production under one corporate management. All these plants have orders for their products to keep them running for a considerable length of time.

The financial end of the consolidation of the properties was managed by Mr. Massey, who also is president of the Ryan-Hampton Tobacco Company, Louisville, Kentucky; Eugene Massey, real estate man of Chicago, Illinois; Howard F. Hansell, Jr., president Frazier & Company, bankers and brokers, New York City; Frank Finsthwait, Finsthwait & Company, New York City; H. J. Meehan, president, John C. Cosgrove, chairman, and J. E. Graham, treasurer of the Cosgrove-Meehan Coal Company, Johnstown, Pennsylvania. Other Pennsylvania capitalists directly interested in financing the undertaking are W. F. Euwer, J. D. Keller and Stephen Pohe, vice-presidents of the Public Service Company, Louisville, Kentucky, and E. J. Bigley, Altoona, Pennsylvania. It is also reported that a large amount of New York, Kentucky, Tennessee and Illinois capital is involved.

The report says that there will be 3,000,000 shares of preferred stock and 100,000 shares of no par common. The properties of the Rock Asphalt Company of America go into the new company at $1,000,000 preferred and others at $350,000. Other financiers will furnish operating capital. The officers of the United Rock Asphalt Company are Fred T. Fitzharris, president; Fred H. Mertens, secretary; J. D. Keller, treasurer, and A. C. Leathers, sales manager. Offices and headquarters of the company have been opened in the Inter-Southern Building, Louisville, Kentucky. Operating offices will also be maintained at other places throughout the country.

Kenova Cement Plant Starts

We are informed that manufacture of Basic Portland Cement began at the Kenova plant of the Basic Products Company shortly after April 1st. This was announced by A. T. Wood, general manager. Machinery for the wet department of the plant has been placed and has undergone thorough tests, Mr. Wood said. Grinding machinery in the dry department has been placed on its foundations, and final tests of its efficiency have been made. Raw materials from the Kentucky mines of the company have arrived at the Kenova plant ready for the manufacturing process.

Cement Corporation Promotes Hilts and Morgan

We are informed that H. Struckmann, president of the Virginia Portland Cement Corporation, has announced a change in the executive position of manager of the corporation. Dwight Morgan, formerly sales manager, has been promoted to the position of manager, following the promotion of H. E. Hilts to be manager of the Cuban Portland Cement Corporation, with offices at Havana, Cuba.

H. C. Boyden Joins Celite Products Co.

Colonel H. C. Boyden, well-known lecturer on cement and concrete, has joined the staff of the Celite Products Company, manufacturers of a workability agent for use in concrete.

Colonel Boyden's talks on concrete are based on his own practical experience of over twenty-five years in concrete. He has designed and built structures requiring nearly half a million cubic yards of concrete. This practical experience is supplemented by a thorough understanding of the theory and design of concrete mixtures. During the War he served in the United States Army Engineers and in 1919 taught at the Engineering School at Camp Humphries, following which he joined the Portland Cement Association in the capacity of International lecturer. After six years lecturing, during which he appeared before over 1200 audiences, he joined the faculty of the Ohio Northern University as Dean of the College of Engineering.

The Celite Products Company is, at the present time, arranging a series of

H. C. Boyden

lectures to be given by Colonel Boyden in cities throughout the United States and Canada. His talks are being presented principally in engineering societies and associations, engineering colleges and also to general clubs and other organizations.

Asbestos Shingle Co. Appoints

The Asbestos Shingle, Slate & Sheating Company, manufacturer of asbestos shingles and a variety of other asbestos building materials, announces the appointment of Mr. D. W. Widmayer as Western sales manager and manager of its new St. Louis factory. Mr. Widmayer has been assistant sales manager of the company for the last six years. With the completion of the new St. Louis factory, which is to start production in a few weeks, all business in territory west of Columbus, Ohio, will be handled from St. Louis.

D. A. Schlemmer Joins Yosemite Portland

We are informed that Dewey A. Schlemmer has become sales manager of the Yosemite Portland Cement Company. He will be located at Fresno, California, where a new sales office will be opened.

United States Gypsum Opens New Offices

New offices of the United States Gypsum Company, the third offices occupied in twenty-five years of business existence, were opened Monday, April 11. At its present address, 300 West Adams Street, Chicago, the company occupies three floors, the area totalling about 62,000 square feet.

An effective contrast is offered between the quarters now occupied and the meager space occupied by the company at its inception twenty-five years ago. Then the company was located in the Women's Temple, torn down this year, and was just embarked on the gigantic task of bringing order out of the chaos of the gypsum industry.

An interesting feature of the new offices is that the walls throughout are finished with Textone, and virtually all the ceilings with Sabinite Acoustical Plaster. This last product was just offered for sale by the United States Gypsum Company in 1926 under license from Dr. Paul E. Sabine of Riverbank Laboratories. Its acoustical efficiency results from its ability to change a certain portion of the sound energy that strikes it into heat. In this way the overlapping of reflected sound waves is minimized, and through the application of a formula perfected by Dr. Sabine, satisfactory acoustical conditions can be assured for any interior before the building is constructed.

Van Valkenburgh is Promoted

We are informed that W. J. Van Valkenburgh, who for six years was assistant sales manager of the Blue Diamond Company and for the last year with the Reliance Rock Company, has been appointed sales manager for the Union Rock Company. He succeeds Walter Moore, Jr., who has become sales manager of the Consumers Rock and Gravel Company. R. L. Vance, formerly sales manager for the Colton Portland Cement Company, has also joined the staff of the Union Rock Company.

Cement Company Enlarges Plant at Cementville

According to a report a contract has been awarded to A. Vogel and Company for the construction of a clinker shed at Cementville for the San Antonio Portland Cement Company. W. E. Simpson and Company are the engineers. The building will be 82 by 180 feet and will have two stories of reinforced concrete and structural steel.

Bowsman Company Enlarges

A report says that the Bowsman Washed Sand and Gravel Company, Piqua, Ohio, are making preparation for a heavy production season. To meet this demand, this company has installed a secondary crusher, two new conveyors, a new bucket elevator to replace a belt conveyor, and a new screen. The production from the plant is approximately 400 yards of gravel a day.

New Cement Plant Starts

We are informed that the West Penn Cement Company at West Winfield, near Butler, Pennsylvania, a two and one-half million dollar corporation officially started operations at their new plant recently. The company is planning to reach a daily output of two thousand barrels and is employing 125 men. The company reports many orders for cement.

Portland Cement Appoints Albion District Engineer

H. R. Albion has been appointed district engineer in charge of the Jacksonville Office of the Portland Cement Association. Before entering the Association employ in 1926 as a field representative in Florida, Mr. Albion had wide experience in engineering practice, including five years as senior partner of the engineering firm of Albion and Ewing.

Pacific Portland Expands

According to a report the Pacific Portland Cement Company is enlarging its factory at Redwood City, California, by constructing two additional steel kilns, each 235 feet long. This expansion will increase manufacturing facilities one hundred per cent.

Equipment Bulletin

The Ross Power Equipment Company has recently issued a bulletin containing a list of new and used equipment which they have on hand. The bulletin describes a number of the following items: air compressors, steam, motor and belt driven; boilers, various sizes and types; blowers, buckets; dump cars; cranes, bridge and locomotive types; conveyors and loaders; crushers of the jaw, disk, roll and gyratory types; dryers and kilns, draglines and drills; shovels of various types and sizes, as well as many other items which are used in the Pit and Quarry industry. Anyone interested may obtain a copy of this bulletin by writing to the Ross Power Equipment Company.

Universal Portland Cement Makes Many Improvements

Expediting shipments of cement throughout the Great Lakes region by supplementing present rail transportation with deliveries by boat to all ports on the lakes will be made possible by the new $2,000,000 harbor improvement just being completed at the Chicago plant of the Universal Portland Cement Company.

The deepest harbor on the Great Lakes, one of the largest and heaviest boat-unloading bridges in the Chicago district, a 55-acre harbor basis, a 30-acre storage yard, an electrically operated belt conveyor nearly a mile long and a lighthouse with one of the brightest beacons on the southern end of Lake Michigan are features of this new development.

The new storage yard with its capacity of a million tons of limestone will insure adequate supplies of raw material necessary for uninterrupted production. The harbor basin affords ample anchor space for several boats. The concrete dock, over 1,800 feet long and 600 feet wide, can accommodate a number of vessels and thus provides at the same time facilities for unloading limestone from Michigan quarries and for loading cement for shipment by boat throughout the Great Lakes region.

The Heltzel Line

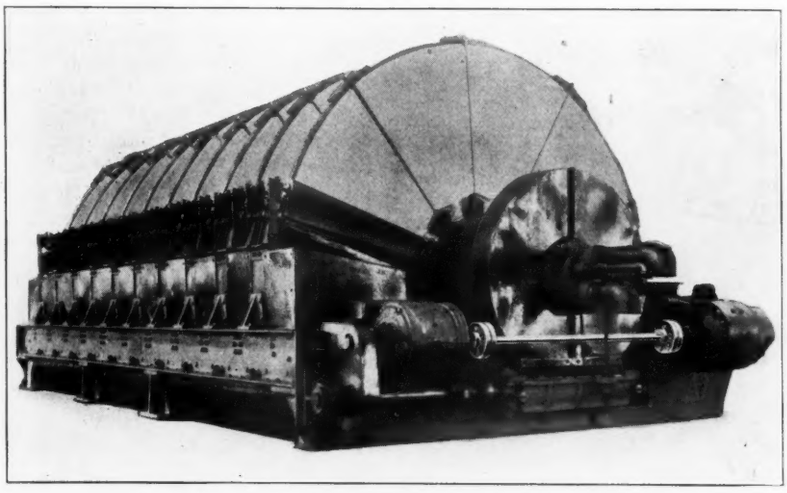
The Heltzel Steel Form and Iron Company manufactures agrabatchers, trailer-agrabatchers, bins and car unloaders which are described in a catalog recently issued by this company.

The agrabatchers are operated by a single lever with one man, which performs the complete operation of filling, cutting off, dumping the batch of sand and stone, closing the lower and opening the upper gates. Hand nuts with four threads per inch are provided for quick and accurate adjustment to compensate for bulking due to moisture content. The sand agrabatcher has a capacity of 8 to 14 cubic feet and stone agrabatcher 13 to 28 cubic feet. These agrabatchers may be separated into individual units by removing four bolts and nuts.

The trailer-agrabatcher bins are made of 35, 55, 80 and 110 capacities. The two larger sizes are made in two halves so that the bin may be trailed readily to any point. When the location is reached, the section with temporary legs is first raised, then the other section and the tightening of a few bolts completes the assembly. Projecting angles on one of the halves simplify the aligning of the bolt holes when erecting. Every bolt is reached either from the platform or from a point reached by permanent steel ladders.

Automatic Filter Driven By Ajax Flexible Couplings

The popular opinion seems to be that an unsupported shaft can not be successfully driven through flexible couplings. However, the American Filter Company, manufacturers of United Continuous Automatic Filters, have successfully used Ajax Flexible Couplings for this work for a long time.



Ajax Flexible Couplings driving Automatic Filter.

The illustration shows an unsupported drive shaft on the drive end of a United Filter, used for dehydrating cement slurry. The motor, mounted on the right side of the filter, drives a shaft 4 feet long through an Ajax Coupling to another Ajax Coupling on the left hand side, which connects with a D. O. James Speed Reducer.

The successful driving of this unsupported shaft is due largely to the precision made parts of the coupling. Rubber bumpers, ground to size, perform the double duty of effecting complete insulation and absorbing shocks; the bumpers are firmly cemented around bronze bushings and into the holes in the flanges, and are so protected from dirt, oil and water.

Hardened, high carbon steel pins or drive-studs are the connecting medium. They are ground to close limits to assure alignment, eliminate friction, and prevent binding and vibrating action. Oilless bronze bushings, impregnated with graphite for self-lubrication, and fitted into the bumpers, furnish a bearing for the steel pins. The couplings are made in jigs to assure accuracy and interchangeability of parts. Two halves of a given size coupling guarantee proper fit, even though they are assembled on different units, preparatory to setting up.

A Large Gasoline Locomotive

What is probably the largest practical gasoline locomotive ever built was recently delivered to the Du Pont Rayon Company by the Geo. D. Whitcomb Company. This is of 30-ton weight and is powered by a six cylinder 6½x7 inches Beaver engine with a rated capacity of 160 horsepower at 1000 revolutions per minute. The draw bar pull is 17,500 pounds on low gear without sand. The frame is of solid type construction, axles of forged steel and wheels with chilled tread, or of any type required by the purchaser. Transmission allows for four speeds forward and four reverse, and sand is furnished at all four wheels. The locomotive is a standard gauge, and is used by the Du Pont Rayon Company for switching work at their Buffalo, New York, plant. This work was formerly handled by a 45-ton steam locomotive, but the steam locomotive was sold after the new gasoline locomotive had demonstrated what it was capable of doing.

The Whitcomb 25-ton and 30-ton gasoline locomotives are in service in several Buffalo plants. A 25-ton Whitcomb in use at the plant of the Dunlop Tire and Rubber Company, recently showed its value when it hauled a train of 19 loaded coal cars estimated to weigh more than 1200 tons, around a curve. These 25-ton and 30-ton locomotives are proving successful because of the special characteristics they embody. The power plant in each is carefully chosen to give an ample margin of power over the specified rating. The low center of gravity and the short overhang are features that give the machine stability and the ability to ride rough track. In action, these gasoline locomotives are flexible and easily controlled. They can spot cars to the fraction of an inch, an important feature in switching and in industrial hauling.

30 Ton Whitcomb Gasoline Locomotive

The Mack Truck

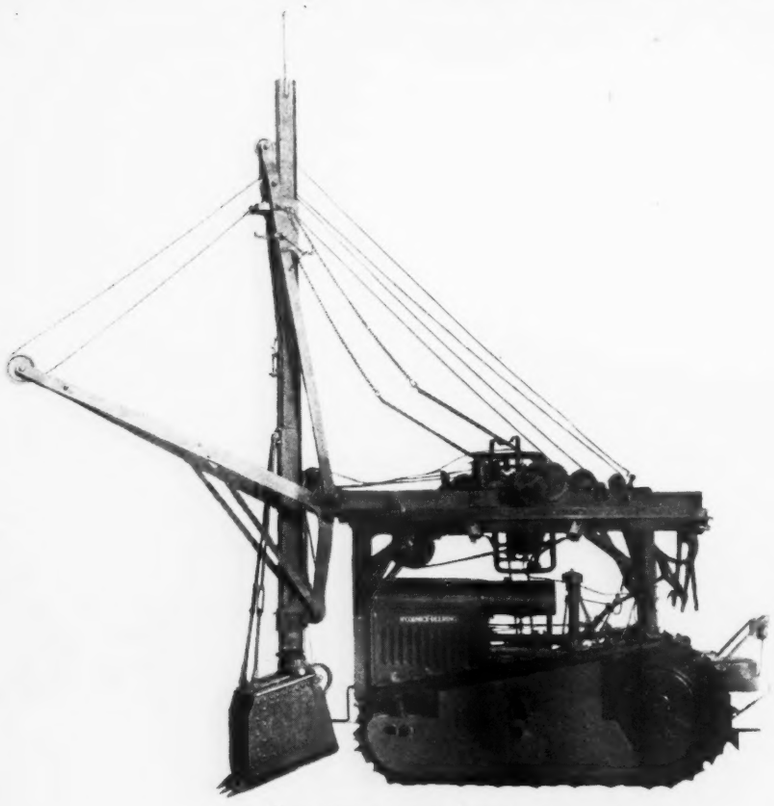
Mack Trucks, Inc., has recently issued a catalog under the title "Why Do They Do It" which is reprint of advertisements of companies who are using the Mack truck in their business.

The book is artistically prepared and is a different type of trade literature than that which is usually published. A glance through the pages impresses the reader very forcibly with the fact that these trucks are being used in almost every type of business, thus showing their universal value.

The last page of the book illustrates several types of Mack manufactures which are trucks, 3½ to 7½ tons capacities, chain drive; 1½, 2 and 2½ tons capacities, chain and dual reduction drive; four and six cylinder busses; four and six cylinder fire apparatus and the Mack rail car.

New Burch Power Shovel

The Burch Plow Works Company recently developed the power shovel shown in the illustration. This machine was first shown at this year's Chicago Road Show. The company are now preparing to place the shovel on the market. The machine can be revolved to a full circle, it is mounted on a 10-20 International tractor with Hadfield-Penfield full crawler treads and is operated entirely from the seat of the tractor.



New Burch Power Shovel

The shovel has a ⅝ yard capacity and the circumference of the operation of the boom is 26 feet 8 inches. The machine has been designed with sufficient power to dig from two to three feet below the track surface of the crawler path. The shovel is claimed to be both quick and easy to operate.

National Slag Association Elects Officers

As a result of election of officers during the Tenth Annual Meeting of the National Slag Association held at the Old Colony Club, Cleveland, Ohio, on April 8th, the following officers were re-elected, for the ensuing year: Mr. C. L. McKenzie, Diamond Bank Building, Pittsburgh, Pennsylvania, president; Mr. C. E. Ireland, Age Herald Building, Birmingham, Alabama, vice president; Mr. H. J. Love, 933 Leader Building, Cleveland, Ohio, secretary-treasurer.

Rol-Man Manganese Steel Screens

Rol-Man Screens are manufactured by the Manganese Steel Forge Company and the use of this equipment is described in a catalog recently issued by this company, entitled "Better Screening at Lower Costs with Rolman Screens." The booklet contains numerous letters from satisfied users showing how these screens have increased the output, materially improved the product, and also provided long life of screens. These screens are woven of rolled manganese steel rods using the double lock mesh weave construction. The material used, manganese steel, combines an extreme tough-hardness with durability to a marked degree. The principle of this double lock mesh is the crimping of all the rods down only, leaving the screening face smooth and flat with no high points to wear through quickly where the rods intersect. It is claimed that by this method raveling or displacement of the rods is prevented and the screen maintains its original size and shape of openings throughout the life of the screen.

These screens are adaptable and easily applied to practically every make and type of screening equipment — vibrating, shaking, inclined gravity and cylindrical, conical and hexagonal revolving. They are made in all shapes, square, rectangular or cut to special shapes; flat, rolled to full cylinder or cone or segments of cylinder or cone and may be made with flanges if so desired. Joints of the screens may be made to lap or to butt, as conditions or preference demand. Lap points, secured with u-bolts at intervals of six to twelve inches, make strong, simple, inexpensive joints. The usual practice is to pass the u-bolt through the mesh openings from inside diagonally across the rod intersections, drawing it up tight against the clamping plate on the outside by means of two nuts on the threaded end. It is advantageous where possible to tie the screens at intervals to the lengthwise trusses of the screen frame. This is done by passing a long u-bolt through the screen from the inside around the truss, passing the threaded ends through holes in a flat tie bar resting across the outside of the truss and then drawing tight against the tie bar with nuts.

Rol-Man screens are made in all sizes from $\frac{3}{16}$ inch square free opening, $\frac{3}{8}$ inch diameter rods to 6 inch free opening of 1¼ inch diameter rods. The booklet is liberally illustrated with views of Rol-Man screens in service and one or two pages are devoted to other Rol-Man products such as chute plates, grizzly bars, flat link chain, etc.

The Federal Triple-A Siren

The Federal electric Triple-A siren for use as a fire alarm is announced by the Federal Electric Company. It is designed to serve also as a start-and-quit-work signal in industrials, factories, and mines. It consists of three sirens mounted on a triangular base. These three sirens are connected in parallel and operate from one push button switch. Each siren has approximately 1/3 horsepower or a total of the Triple-A, of one horsepower.

The tone of each of the three sirens is different from that of the other two. With a siren mounted on each angle of the triangular base, the Triple-A penetrates in every direction and has a sound radius of from ⅜ to ½ mile under normal conditions.

It is extremely simple in construction and is entirely enclosed. There is nothing to rust or corrode as the motor-housings, stators, and rotors are die cast from high-grade aluminum.

According to a report operations have been started by the Cooper Quarry Company of Plymouth, Pennsylvania. Over $100,000 has been spent on improvements and the plant now has a capacity of 600 tons of material per day.

Westinghouse Air Compressors

The Westinghouse Air Brake Company manufactures a varied line of air compressors. One of these is a steam driven cross compound type. This compressor is applicable where a large volume of air is required. It is claimed to have not only a large capacity but also, high efficiency and economy in steam consumption. Both the steam supplied and the air compressed are compounded, combining maximum capacity and high efficiency.

Three types of motor driven air compressors made by this company are known as types N, NW and QL. Type N, not water cooled, is built in sizes of 12½ to 60 cubic feet displacement and is designed for intermittent service, with limited intervals of work and rest. Type NW is of the same design as the N type and is also built in sizes of 12½ to 60 cubic feet displacement, but being designed for continuous service has water jacketed valve heads. These NW type can also be equipped with a type P automatic water governor which automatically starts the flow of water when the compressor begins to operate and shuts off the flow of water when the compressor is idle.

The type QL compressors with piston displacements varying from 9.1 to 35.8 cubic feet per minute are intended for service when conditions necessitate the constant delivery of air at high pressures, within the maximum limits, however, of either 200 or 350 pounds. These compressors are of the compound type with low pressure valves and high pressure valves and cylinders, water cooled for continuous operation.

Types 3VS and 3VD are also motor driven. The former is a three cylinder, single stage, single acting compressor built in various sizes, to operate against pressures up to 150 lbs. The cylinders and valve heads are water jacketed. The latter type, 3VD, is also a three cylinder, single stage, but is double acting and designed to operate against pressures up to 120 lbs., and varying in capacities from 475 to 700 cubic feet displacement. The cylinders and valve heads of this type are also water jacketed.

Another type made by this company is known as the 2V compressor. Of this type 2VSA is single stage, air cooled and designed for intermittent service. These compressors are furnished in the following displacements: 75 cubic feet at 40 pounds pressure; 100 cubic feet at 40 pounds pressure; and 150 cubic feet at 30 pounds pressure. Type 2VSV is single stage, water cooled and designed for continuous service, having water cooled cylinder and heads being equipped with type P water governor. These compressors are regularly built in displacements of 75, 100 and 150 cubic feet per minute and for pressures up to 100 pounds. The 2VCA is of the compound, two stage, air cooled type, with one low pressure and one high pressure cylinder, requiring intercooler and designed for continuous service. They are built in displacements of 75, 100 and 150 cubic feet per minute, suitable for pressures from 85 to 115 pounds.

New Novo Distributor

H. E. Erickson Company, Minneapolis, Minnesota, has recently been appointed exclusive Novo distributors in the north central territory. This organization will handle the complete line of Novo engines, hoists, pumps, and combination outfits.

The George Haiss Manufacturing Company are now represented in the Philadelphia territory by their own factory representative, Mr. Ralph H. Smith, Buist Avenue & Berbro Street, West Philadelphia, Pennsylvania.

1926 Hydraulic Cement Output Greater Than 1925

Statistics of hydraulic cements, other than Portland cement, in 1926, which include masonry, natural, and puzzolan cements, as compiled by the United States Bureau of Mines, Department of Commerce, show that the production—2,104,891 barrels—exceeded that of 1925 by nearly 22 per cent. Shipments of these cements from mills in 1926 increased 16 per cent in quantity and about 11 per cent in gross value. Stocks at the mills also increased and were about 68 per cent higher at the end of 1926 than at the end of 1925.

These statistics represent the output of 11 plants in 1926, which are located as follows: One each in Alabama, Illinois, Indiana, Kansas, Kentucky, Ohio, and Pennsylvania; and two each in Minnesota and New York. One new plant, in New York, began production of natural cement in 1926. The output has been expressed in terms of 376-pound barrels to correspond with the statistics of portland cement.

General Excavator Issues New Bulletin

The General Excavator Company has recently issued bulletin 2703 describing how the General Excavator is built and what materials are used in its manufacture. The castings are all made in foundries of Associated Companies and are therefore under this company's supervision. More than 90 per cent of these castings are made of electric furnace and open hearth cast steel, Titanium treated. The shafts are made from hot worked hammered steel, which assures a dense, close grained, tough and uniform metal. The few gears used are machine cut from the solid with one exception. Liberal surface bearings provided with ample lubrication are used in this machine.

Descriptions of the main drive, main clutch, drums, side frames, clutches, controls, crowding mechanism, power boom hoist, travel motion, swing motion, etc., are also given in the bulletin. Diagrams of working ranges and specifications and illustrations of the various details entering into the construction of the excavator make this book both interesting and instructive.

Asbesgraphite

Asbesgraphite is a self-lubricating, non-scoring asbestos friction material manufactured by Thomas L. Gatke. This material is molded into brake and friction blocks to suit any requirement. Some of the claims for Asbesgraphite are that it has a long life, withstands severe service; operates with a soft, cushion-like effect, keeping the housing in a smooth, highly-polished condition; self-lubricating, non-scoring, thus keeping the friction surfaces in a smooth condition; no expansion or contraction caused by change in temperature; does not absorb oil, neither will it admit moisture in any quantity.

This company also manufactures a folded and compressed asbestos brake lining under the name of "Ektag." This lining is also made to suit any special requirement.

Mr. C. W. Ferguson, formerly advertising manager of the Speeder Machinery Corporation, has recently been appointed sales manager of the O. K. Clutch and Machinery Company.

Masonry, Natural, and Puzzolan Cements Produced, Shipped, and in Stock in the United States, 1925 and 1926

Year	Active plants	Production Barrels	Shipments Barrels	Shipments Value	Stock (Dec. 31) Barrels
1925	10	1,729,343	1,751,725	$2,551,583	107,459
1926	11	2,104,891	2,031,851	2,820,110	180,499

Rates for display advertisements in the Broadcast Section are given below. If you want to buy or sell used equipment, if you want a job or need a man, advertise your wants in Pit and Quarry. Advertisement copy for publication in the next issue should reach our office within one week after the date of this issue.

RATES PER INSERTION	1 Inch	2 Inches	3 Inches	4 Inches	5 Inches	6 Inches	8 Inches	9 Inches	10 Inches	12 Inches	15 Inches	20 Inches	30 Inches
1 Insertion	$3.75	$7.25	$10.75	$14.25	$17.75	$21.25	$28.25	$31.75	$35.25	$42.25	$56.25	$70.25	$105.00
2 Insertions	3.75	7.25	10.70	14.20	17.65	21.15	28.15	31.65	35.15	42.15	56.15	70.00	104.00
3 Insertions	3.75	7.20	10.65	14.15	17.55	21.05	28.05	31.55	35.10	42.05	56.05	69.75	103.00
4 Insertions	3.70	7.15	10.60	14.10	17.45	20.95	27.95	31.45	35.00	41.95	55.90	68.75	101.00
8 Insertions	3.65	7.05	10.50	14.00	17.25	20.75	27.75	31.25	34.80	41.75	55.70	67.50	98.00
13 Insertions	3.60	6.95	10.40	13.90	17.05	20.55	27.55	31.05	34.60	41.55	55.55	66.25	94.00
26 Insertions	3.50	6.75	10.20	13.70	16.65	20.05	27.05	30.65	34.20	41.05	55.05	64.00	88.00

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Complete Service Publishing Company

538 South Clark Street **CHICAGO**

FOR SALE OR RENT

All equipment overhauled in our Shop is furnished in guaranteed condition, subject to thirty days' trial in service.

STEAM SHOVELS—RAILROAD TYPE

1—Model 80 Marion, Shop No. 1312, 4 yd.
3—70-ton Bucyrus. Shop Nos. 920, 939, and 1233. 2½-yd. dippers.
1—Model 60 Marion. Shop No. 2059, 2½-yd. dipper.
2—60-C Bucyrus. Shop No. 1286 and 1640, 2½-yd. dippers.
1—45-C Bucyrus. Shop No. 1202. 1¾-yd. dipper.

SHOVELS—FULL REVOLVING

1—80-B Bucyrus, Shop No. 4002, New November, 1923, caterpillars, 41-ft. 6-in. Boom, 34-ft. Dipper Arm and 2½-yd. dipper.
2—50-B Bucyrus. Shop Nos. 3821, 4216, caterpillars, 26-ft. boom, 17-ft. stick and 1¾-yd. dippers. Oil burner.
1—37 Marion. Shop No. 4773, 32 ft. boom, 22 ft. dipper arm, 1¼-yd. dipper. Caterpillars.
1—Model 104 Northwest, Shop No. 1051, 1-yd. dipper, steel caterpillars.
1—K-2 Link Belt, Shop No. 1068, 1-yd. dipper, steel caterpillars.
4—Type "B" Eries. Shop Nos. 1614, 2144, 2152 and 3392 high lift, ¾-yd. Steel caterpillars.
1—Model 21 Marion. Shop No. 4294, steel caterpillars, ¾ yd.
1—Model 21 Marion Gas-Electric. Shop No. 4550, caterpillars, standard boom, ¾-yd. dipper.
1—Type O Thew, Shop No. 1777, high-lift, traction wheels, 2/3-yd. dipper.
1—18-B Bucyrus. Shop No. 1870, ⅞-yd. dipper. Traction.

SIDE DUMP CARS

9—30-yd. Western, all-steel, air dump.
20—20-yd. Western, all-steel, air dump.
12—18-yd. Western, all-steel.
69—16-yd. Western, wood beds, air dump.
85—12-yd. Western Side Dump, wood beds.
2—6-yd. K. & J. Steel Sills Truss-rod doors.
2—5-yd. K. & J. 36-in. ga. Steel drawsills, wood beds.
8—2-yd. Western, 36-in. ga., wood drawsills, wood beds.
4—1½-yd. Western, 24-in. ga., wood beds.

STEAM SHOVEL PARTS

All repair parts on hand for Model 60 Marion and standard 70-ton Bucyrus Steam Shovels.
1—Std. boom, dipper arm and ¾-yd. dipper for Type "B" Erie.
2—32-ft. and 40-ft steel boom, drum, etc. for Type "B" Erie Crane.

LOCOMOTIVES

1—19x24 Baldwin 6-wheeled Saddle Tank. Shop No. 49553. Weight 67 tons, 180 lb. steam pressure. Air brakes.
1—19x24 Baldwin Mogul, Shop No. 30,314, wt. 61 tons, 180 lb. steam pressure, air brakes.
1—18x24 American Six-wheeled Switcher. Shop No. 47677, weight 52 tons, 170 lb. steam pressure.
1—18x24 Baldwin 6-wheeled Switcher. Shop No. 25044, wt. 50 tons, air brakes.
1—16x24 Davenport 4-wheeled switcher, Shop Nos. 858. Wt. 40 tons. Air brakes.
1—11x16, Standard Gauge Porter four-wheeled, saddle tank, Shop No. 6757, A.S.M.E. boiler. New 1922.
1—14x20 Davenport 4-wheeled saddle tank, Shop No. 2046, wt. 40 tons, 180 lb. steam pressure, A.S.M.E. boiler.
1—10x16 Porter 4-wheeled Saddle Tank. Shop No. 4251, wt. 19 tons, 165 lb. steam pressure.
2—10x16 Baldwin, 36-in. ga., 4-wheeled Saddle Tanks. Wt. 19½ tons. Shop Nos. 12161 and 28353.
1—9x14 Porter 36-in. gauge saddle tank. Shop No. 6960.
2—30-ton Climax Locomotives, 36-in. ga. New 1925.
1—7-12 Davenport and Vulcan, 24-in. gauge, 9-ton dinkies. Shop. No. 1567.
1—6-ton, 24-in. gauge Whitcomb Gas, gear drive, Shop No. 1259.

DRAGLINE EXCAVATORS

1—Class 24 Bucyrus. Shop No. 859, equalizing trucks, 100-ft. boom, 3½-yd. Page bucket. A.S.M.E. boiler.
2—Class 20 Bucyrus Draglines. Shop Nos. 740 and 813, 85-ft. booms, 2½-yd. dragline buckets. Skids and rollers.
2—Class 14 Bucyrus, steam operated. Shop Nos. 2140 and 3706, steel caterpillars, 60-ft. boom, 2-yd. bucket. A.S.M.E. boiler.
1—Class 14 Bucyrus, Shop No. 745, skids and rolls, 60-ft. boom, 2-yd. bucket.
2—No. 2 Monighan steam operated. Shop Nos. 789 and 1587, skids and rollers, 60-ft. boom, 2-yd. Page bucket.
1—K-2 Link Belt, gasoline, Shop No. 1068, 50 ft. boom, 1-yd. Page Bucket, steel caterpillars, new 1925.
1—Model 104 Northwest, Shop No. 1051, 45-ft. boom, 1-yd. bucket, steel caterpillars.
1—30-B Bucyrus Shop No. 3641, steel caterpillars, 40-ft. boom, 1-yd. Page bucket.
1—Model 210 P&H Gasoline Dragline, Shop No. 1077 Armored caterpillars, 40-ft. boom, 1-yd. Page bucket.
1—Model 21 Marion Gas-Electric, Shop No. 4550, caterpillars, 36-ft. boom, ¾-yd. Page bucket.

CRANES

1—K-2 Link Belt, gasoline, Shop No. 1068, 50-ft. boom, bucket-operating, steel caterpillars, new 1925.
1—15-ton Brownhoist 8-wheeled Crane. Shop No. 4520.
1—20 ton Brown Hoist, Shop No. 6588, M.C.B. Trucks, 50 ft. boom, bucket operating.
1—20-ton McMyler, No. 388, 50-ft. boom, bucket-operating.
1—21-ton Industrial 8-wheeled Crane. Shop No. 2706. 50-ft. boom, bucket operating.
1—Type "B" 23-ton McMyler, Shop No. 3265, MCB trucks, 50-ft. boom, bucket-operating.

BUCKETS

1—¾-yd. Lakewood clam shell.
1—1¼-yd. O. & S. Clam Shell.
1—1-yd. Blaw-Knox Dreadnaught with teeth.
1—1-yd. Class "M" Page Dragline Bucket.
1—1½-yd. Brownhoist Clam Shell.
1—1½-yd. Mead-Morrison Clam Shell.
1—1-yd. Browning, Digging Type with teeth.
2—1½-yd. Page Dragline Buckets.

MISCELLANEOUS

10—50 ft. Camp Cars.
1—Standard gauge Nordberg Track Shifter, gasoline operated.
1—10-ton Austin 3-wheeled Gaso. Roller.
1—60-ton Lidgerwood Unloader with side plows.
1—No. 7-S Knickerbocker Concrete Mixer, with power loader and water tank on trucks. New.
1—American Railroad Ditcher No. 459.
1—8-ft. Austin Giant Road Grader.
1—6½x10 D.C., D.D. American Hoist, with butt strapped boiler.
35—Milburn Carbide Lights.
1—No. 55 Buhl Portable Air Compressor.
1—Set Pile Driver Leads. 42-ft. long.
12—New Drag Scrapers.
1—Model 10 Keystone Mixer, low charger, 6 Hp. Novo Gas Engine.
1—No. 6 Keystone Mixer, 3 Hp. Novo Engine.

CLAPP, RILEY & HALL EQUIPMENT CO., 14 No. Clinton St., Chicago, Ill.
BECK, RILEY & HALL EQUIPMENT CO., 458 Union Trust Bldg., Pittsburgh, Pa.

FOR SALE

1—No. 5 Telsmith crusher, late type. Used on one road job 23,000 yds. Practically new $1600.00.
10—Western Rock Dump Carts, steel lined, with harness. Pratically new. $45.00 each.
1—3-ton Plymouth Gasoline Locomotive and 6 2-yd. Koppel 36 in. gauge side dump cars. 90% new. All for $1200.00.
1—Portable Schram Compressor. Factory rebuilt. $650.00.

M. WENZEL, 4029 S. Benton, Kansas City, Mo.

100—NEW V-DUMP CARS

1½ & 1 cu. yd. x 24 in. and 36 in. Gage
Immediate Shipment
Quick to Move—Attractive Prices

Also New and Relaying Rails—Portable Track

New York City Park Row Bldg. **M. K. FRANK** Pittsburgh, Pa. Union Trust Bldg.

and the development of its use in pulverizing, separating, drying and conveying powdered materials.

In 1887, the introduction of Raymond Mills with Air Separation completely revolutionized the pulverizing industry.

Economic necessity forced out the crude methods and uncertain results of that time, and established the Raymond system as the standard of efficiency in the fine grinding of a great variety of products.

Today, competitive conditions have grown so keen that a greater need than ever exists for substantial

REDUCTIONS IN COSTS

not only in pulverizing but also in handling powdered materials.

It is to meet this present demand that we have made many new improvements and developments in Raymond equipment—with the utilization of air as an important factor in the operation of the machines.

Our complete line of **Imp Mills** is adaptable to a host of industries, where individual units of small capacity are required.

For huge production, the 25-ton-per-hour **Super-Screen Mills** surpass all previous performance in capacity and economy.

The latest achievement of our engineers is the new **Kiln-Mill,** capable of drying and grinding at the same time—it eliminates the expense of dryer apparatus!

The new Raymond **Transporter** uses air as a carrier to take the place of the usual type of elevators and conveyors in transporting pulverized products.

GENUINE SAVINGS

are assured to your plant by Raymond installations, made by Raymond methods, which take into account your special needs.

We shall be glad to study your problem, and tell you definitely what can be accomplished.

Let us mail you a copy of this new book describing Raymond equipment and methods for reducing the cost of pulverizing and handling materials.

THE RAYMOND BROS. IMPACT PULVERIZER CO.

A Subsidiary of the International Combustion Engineering Corporation

1321 N. Branch St., Chicago

342 Madison Ave., New York **Subway Terminal Bldg., Los Angeles**

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1—9x14 Porter 36-in. gauge saddle tank. Shop No. 6960.
2—30-ton Climax Locomotives, 36-in. ga. New 1925.
1—7-12 Davenport and Vulcan, 24-in. gauge, 9-ton dinkies. Shop. No. 1567.
1—6-ton, 24-in. gauge Whitcomb Gas, gear drive, Shop No. 1259.

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1—30-B Bucyrus Shop No. 3641, steel caterpillars, 40-ft. boom, 1-yd. Page bucket.
1—Model 210 P&H Gasoline Dragline, Shop No. 1077 Armored caterpillars, 40-ft. boom, 1-yd. Page bucket.
1—Model 21 Marion Gas-Electric, Shop No. 4550, caterpillars, 36-ft. boom, ¾-yd. Page bucket.

CRANES

1—K-2 Link Belt, gasoline, Shop No. 1068, 50-ft. boom, bucket-operating, steel caterpillars, new 1925.
1—15-ton Brownhoist 8-wheeled Crane. Shop No. 4520.
1—20 ton Brown Hoist, Shop No. 6583, M.C.B. Trucks, 50 ft. boom, bucket operating.
1—20-ton McMyler, No. 388, 50-ft. boom, bucket-operating.
1—21-ton Industrial 8-wheeled Crane. Shop No. 2706. 50-ft. boom, bucket operating.
1—Type "B" 23-ton McMyler, Shop No. 3265, MCB trucks, 50-ft. boom, bucket-operating.

BUCKETS

1—¾-yd. Lakewood clam shell.
1—1¼-yd. O. & S. Clam Shell.
1—1-yd. Blaw-Knox Dreadnaught with teeth.
1—1-yd. Class "M" Page Dragline Bucket.
1—1½-yd. Brownhoist Clam Shell.
1—1½-yd. Mead-Morrison Clam Shell.
1—1-yd. Browning, Digging Type with teeth.
2—1½-yd. Page Dragline Buckets.

MISCELLANEOUS

10—50 ft. Camp Cars.
1—Standard gauge Nordberg Track Shifter, gasoline operated.
1—10-ton Austin 3-wheeled Gaso. Roller.
1—60-ton Lidgerwood Unloader with side plows.
1—No. 7-S Knickerbocker Concrete Mixer. with power loader and water tank on trucks. New.
1—American Railroad Ditcher No. 459.
1—8-ft. Austin Giant Road Grader.
1—6½x10 D.C., D.D. American Hoist, with butt strapped boiler.
35—Milburn Carbide Lights.
1—No. 55 Buhl Portable Air Compressor.
1—Set Pile Driver Leads. 42-ft. long.
12—New Drag Scrapers.
1—Model 10 Keystone Mixer, low charger, 6 Hp. Novo Gas Engine.
1—No. 6 Keystone Mixer, 3 Hp. Novo Engine.

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10—Western Rock Dump Carts, steel lined, with harness. Pratically new. $45.00 each.
1—3-ton Plymouth Gasoline Locomotive and 6 2-yd. Koppel 36 in. gauge side dump cars. 90% new. All for $1200.00.
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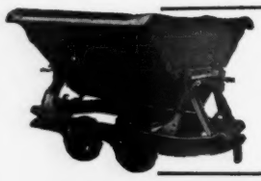

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